Principles and Practice *of* Crown and Bridgework

A practical, systematic and modern treatise upon the requirements and technique of artificial crown and bridgework.

WITH 1160 ILLUSTRATIONS

FOURTH EDITION

BY

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TO MY FRIENDS

TRUMAN W. BROPHY, LL.D., M.D., D.D.S.,

AND

RODRIGUES OTTOLENGUI, M.D.S., LL.D., D.D.S.,

In recognition of their personal and professional attainments, and as a small
evidence of appreciation of their friendship, and of gratitude
for their counsel and assistance

THIS BOOK IS RESPECTFULLY INSCRIBED

BY THE AUTHOR.

Preface.

The development of the specialty of crown and bridgework, and particularly of the methods of crowning teeth, has been so rapid that it has probably been difficult, if not indeed quite impossible, for the average practitioner to keep apace with the numerous modifications of, and improvements in, the various methods of procedure which have been constantly presented and advocated in the evolution of this specialty from a somewhat chaotic, and at best unsystematic beginning, to its present acknowledged position as a distinct and highly artistic and practical department of dental prosthesis.

It is therefore believed that there is a need at the present time for a strictly modern text and reference book, embracing a tangible, systematic and practical classification of the subject, supplemented with adequate illustrations.

In assuming to supply such a possible need an effort has been made to present the subject matter in a practical and concise form, and in a more or less systematic and sequential order; as well as to avoid, in so far as possible, any consideration of methods which may have proven, or which are deemed, to be impracticable; or those which may have been abandoned, or have become obsolete.

Special care has been given to the presentation of the various methods which are practiced, and which are recognized as possessing merit and practicability. This is deemed warrantable, and indeed essential, for the reason that in the successful practice of a specialty in which a very high order of art and mechanics is demanded, and which involves more or less permanent application as a part of the human economy, where the conditions presenting are so greatly diversified, there is no *one best* method. Some procedures will be found more applicable to one case than to another, and to be more practical and successful in some hands than in others.

Personal equation and good judgment will dictate and enter largely into, the application of the most practical method to be pursued in each case, and this will usually have as much bearing upon the success and serviceability of the operation contemplated, as will the degree of skill which may be exhibited in the execution of the details of construction.

The various methods and technique of modern procedures are presented and commented upon from an original and unbiased viewpoint. This is done with the belief that their respective application and practicability will thus probably be more logically elucidated; and that their merits will be less likely to be overestimated, than if they were presented in the language of the original advocate, because of the enthusiasm which would thus naturally tincture the claims made for them.

In so far as possible every effort has also been made to acknowledge and give due credit as to the origin of the many valuable and ingenious ideas and suggestions which have aided so much in the development of this class of work, and in placing this specialty upon a somewhat sound, systematic and practical basis; as well as to those which have served to facilitate and expedite the procedure and to relieve the patient of any unwarranted or unnecessary discomfiture incident to the operation.

Where several similar methods of detail are mentioned in connection with a single mode of procedure, they are invariably placed in the order of their preference, unless otherwise emphasized in the text.

All reference to the therapeutic, or surgical technique possibly indicated in the treatment of pathological conditions involving the roots of teeth, or surrounding tissues, has been purposely avoided, in the belief that such matter more properly belongs to works on therapeutics *per se,* rather than to a book which is designed only as a practical, and comprehensive elucidation of the principles, practice and technique of modern methods of crowning teeth.

HART J. GOSLEE.

Chicago, Ill., April 30th, 1903.

PREFACE TO SECOND EDITION.

In revising the first edition the changes and additions demanded by the advance of time, and the progress made, were surprisingly few. This is particularly gratifying to the author, and he is deeply grateful to the profession for its approval and support of his efforts.

The addition of the Chapters on Bridgework, and the change of title made necessary thereby, are but a part of the original plan which was unavoidably delayed because of the amount of work involved in an effort to present with some definite and practical classification and system, a subject which has heretofore been little less than a "bewildering and chaotic mass of details," and consequently primitive and empirical.

As applied to bridgework this is particularly true, and while the growth and development of this specialty has been nothing short of

phenomenal, and while many of the bright minds of the profession have contributed toward its progress, yet, there has always been a lack of co-ordination of thought, and co-operation of effort such as would result in a practical classification of requirements, methods and results, and without which the whole application must otherwise remain tinctured, as it were, with empiricism.

In view of the possibilities of this specialty as an art, and of its importance as a means of reuniting and inseparably binding together all of the various departments of practical dentistry, and thus aiding in the further development of the profession as a whole, and for the reason that in previous attempts no general system has obtained and no unification of principles has prevailed, such an effort was thought to be needed, and has been the object and the inspiration of this work from the very beginning. If, therefore, it should but aid in placing artificial crown and bridgework on a broader scientific and practical basis, where so high and useful an art properly belongs, and must ultimately be placed, the result will more than repay the effort.

HART J. GOSLEE.

Chicago, Ill., February 10, 1907.

PREFACE TO THE THIRD EDITION.

Aside from the fundamental principles and particularly in so far as the technique of construction is concerned, the practice of crown and bridgework has been so completely revolutionized by the application of the casting process as to render many of the former modes of procedure almost, if not entirely, obsolete, and to demand, therefore, a careful and comprehensive consideration of the improved and more modern methods.

Although it be true that in almost every application to the technique of construction, much better results have been made possible, and are now to be obtained by, or in combination with, the casting process, in some form or other, nevertheless, our former methods of procedure will always be of practical value as a means of affording a broad knowledge of the subject, and be more or less useful as a matter of record and reference.

Indeed, all methods, even including those which may now perhaps be obsolete, have served as stepping-stones to the present status of the art, and whilst the experts in crown and bridgework to-day might seriously look upon some of them as quite useless, still it must be remembered that their own knowledge of the subject in general, and the degree of skill which they have acquired, has come to them through working with these other methods.

Hence the efforts of the teacher will be enhanced by duly explaining all the older methods, together with the newer ones, thus leading the mind of the student to a better comprehension of the evolution which has taken place. And, moreover, if these older methods should be entirely cast out of the literature, it is possible that in the not distant future they might be brought forward again as new.

It is, therefore, gratifying to the author that the second edition should have been exhausted at a time when the possibilities for improvement are so conspicuously apparent, and becoming so generally recognized; and when the addition of a chapter embracing the application of the casting process is so essential to a modern consideration of the subject.

In presenting the third edition the author has made every effort to emphasize the splendid achievements and far-reaching possibilities of this process as applied to crown and bridgework; to encourage and stimulate an appreciation of them, and by such addition, together with a careful revision of the former editions, to keep the work up to the systematic standard and high ideals which have heretofore directed his efforts and been his chief ambition.

HART J. GOSLEE.

Chicago, Ill., August 22, 1910.

PREFACE TO THE FOURTH EDITION.

The appearance of the fourth edition at this time becomes necessary because former editions have been exhausted. This is gratifying to the author for the reason that it enables him to keep the book up to the very latest moment, which has always been one of his ambitions, and which is necessary in these days of rapid progress and advancement. It is also gratifying because it bespeaks an appreciation on the part of practitioners, teachers and students which is encouraging.

The addition of the more modern methods of removable bridgework, and of the author's own methods and technic of crown construction, indicate the extent to which the casting process, together with other contributory improvements, has revolutionized our methods of practice, all of which was prophesied from the very advent of this process.

With these improvements former empirical methods have been supplanted to such an extent as to make it possible to practice artificial crown and bridgework along more or less definite and systematic lines, and it is hoped that the full possibilities of the present day will be grasped and applied, and that more system and method in this line of work will be cultivated and developed.

HART J. GOSLEE.

Chicago, March 4, 1913.

Principles and Practice of Crown and Bridgework.

History and Development of Crown Work.

CHAPTER I.

Primitive Application of Crowns. First Application of Porcelain Crowns. The Use of English Tube-Teeth for Crowns. The Foster Crown. The Mack Crown. The Shell or Telescope Crown. The Gates-Bonwill Crown. The Howland-Perry Crown. The Richmond Crown. The Büttner Crown. The How Crown. The Weston Crown. The Logan Crown. The Brown Crown. The Webb Crown. Application of Porcelain to Crown Work. Various Modifications of These Principles.

While dental literature as early as the beginning of the eighteenth century records instances of the application of *pivot* teeth to roots, the practical introduction of artificial substitutes for the natural crowns of teeth lost through accident, or by the process of caries, and the ultimate development of crown and bridgework is purely the product of the last half of the nineteenth century, and must be placed to the credit of American dentistry.

As the profession itself has from humble environments grown and broadened into a scientific calling with marvelous rapidity, so also has the specialty of crown and bridgework, the evolution of the application and construction of which forms an interesting chapter in any history of the conception, progress and advancement of all that pertains to dental art and prosthesis.

Besides opening new fields for higher artistic conceptions, it has also materially affected the general advancement of the profession, for at one time it seemed propitious and apparently inevitable that the latter should become divided into the separate branches of operative and mechanical dentistry, and that it would be the exception rather than the rule

for the average person to attain a degree of proficiency in both branches so dissimilar to one another.

This specialty, however, then just budding into general favor by the recognition of its possibilities, and so equally dividing the labor involved between the mind and the hand, the chair and the laboratory, soon proved the fallacy of such thoughts, and resulted in reuniting these branches, thus greatly encouraging the unprecedented advance which the profession has since made.

To crown and bridgework also can be attributed much of this progress, for no field in art or mechanics offers greater opportunity for the display of individual skill and artistic attainments.

The employment of these talents in any line cultivates the finer instincts, promotes a higher sense of appreciation of nature, and draws a

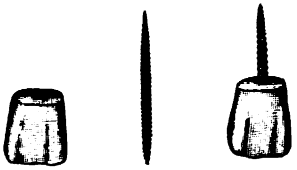

Fig. 1.

Fig. 2.

fine line of distinction between the tradesman or artisan and the true artist; and, in the province of dentistry, enables one to more nearly imitate, and often improve upon, the normal or abnormal conditions which lend so much to the appearance and comfort of those who might otherwise be prematurely disfigured or permanently subjected to discomfiture.

Primitive Application of Crowns.

From available records the first application of "pivot teeth" is described in Fauchard's work, published in 1728, in which mention is made of a crown fastened to the root with a pivot, and which consisted of a crown carved out of bone or ivory, or one of a natural tooth, mounted upon the root with a roughened pivot of silver or gold. The interior of the root was first filled with lead, into the center of which a hole was afterward drilled for the reception of the pivot, the other end of which had been previously cemented in a hole in the crown. Fig. 1.

First Application of Porcelain Crowns.

In the work of de Chemant, published in 1816, nearly one hundred years later, much reference is made to the use of "mineral paste," and a brief description is given of "a single tooth with pivot," accompanied with a crude illustration, which indicates that it was intended as a crown to be attached to a root. Fig. 2.

While other designs of "mineral" teeth were subsequently recorded in French literature, in which country porcelain was first applied, it was not until about 1840 that much effort was made toward the preservation of broken-down roots, or much thought given to the problem of restoring lost crowns of teeth, the prevailing and common practice having been to extract them and insert plates; or, in some instances, to grind them down even with the tissues and retain them for the purpose of preventing alveolar absorption.

English Tube Teeth.

About this time more progressive and esthetic ideas were conceived which resulted in the introduction and first practical application in this country of artificial crowns, in the form of the English tube-teeth, designed and previously used for plate work. These were ground to fit the root and mounted with pivots of hickory wood. This was conceded to be a marked step in advance—a revelation indeed—and proved

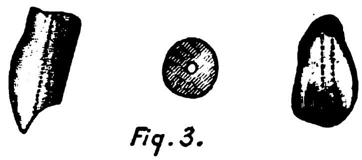

Fig. 3.

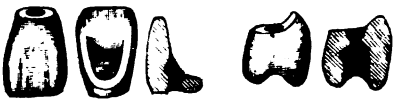

Fig. 4.

the formative period of that class of work which was destined to develop into such an important specialty. But the theory of the wooden pivot serving as a means of anchorage by virtue of the expansion incident to the absorption of moisture soon proved impracticable, because of the inadequate stability, and not infrequent occurrence of fractured roots as a result of the swelling of the wood, as well as the necessary presence of moisture which induced decay. Fig. 3.

Some modifications of this method are recorded whereby effort was made to overcome the objectionable features and permit of the removal of the crown in order to facilitate the treatment of the roots, which developed into a necessity as the result of sealing them up without proper aseptic considerations.

The most prominent of these were the crown attachment patented in 1844 by Dr. J. S. Dodge, which consisted of mounting a wooden tube into the root and attaching a metal dowel to the crown with plastics, which fitted closely into the cylinder of wood, yet rendered its removal easy; and the design of Dr. F. H. Clark, patented in 1849 and comprising the insertion of a metal tube in the root which was anchored securely with a

large-headed screw-pivot, perforated through the center to allow accumulated gases to escape. To the projecting or free end the crown was attached.

The Foster Crown.

Because of the tendency of these crowns to loosen in their attachment to the pivot, and the objections to wooden pivots, the Foster crown was patented in 1855, and while constructed upon almost the same lines as one designed some five years preceding it, by Dr. Henry Lawrence, it enjoyed quite an extensive use for a number of years under the former name. It possessed almost a flat base, with a perforation in the body of the porcelain so shaped as to form a seat for the accommodation of the enlarged head of a screw-pivot, by which means it was anchored securely to the root. Fig. 4.

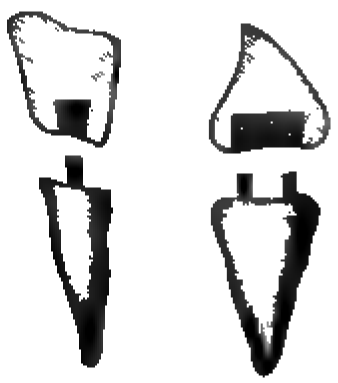

Fig. 5.

Fig. 6.

The Mack Crown.

While in the former styles the dowel was first attached to the crown and then subsequently to the root, the design of Dr. C. H. Mack, patented in 1872, is recorded as the first instance where the dowel was attached firmly in the root before the crown was fixed in place upon it. The crown was constructed with a countersunk cavity in the body of the porcelain which, being filled with plastics, anchored it securely when mounted. Fig. 5.

The Shell or Telescope Crown.

The difficulty experienced in adapting any of the former styles to the posterior teeth in a practical or permanent manner, and the desirability of restoring and preserving their normal functions, ultimately led to the invention of the gold shell or telescope crown, patented by Dr. J. B. Beers in 1873, though probably first suggested by Dr. W. N. Morrison some few years previously.

This crown proved a great step in the line of progress and development, because the construction did not require the sacrificing of tooth

structure to the extent necessary for porcelain crowns, and made possible the better and more serviceable reproduction of natural tooth forms. The seam of union between crown and root was for the first time carried under or within the free margin of the gum and apparently made the operation a more permanent success than had theretofore seemed possible. Fig. 6.

The success and practicability of this style of crown has resulted in the subsequent invention from time to time of innumerable systems and methods of construction, all of which while varying in detail accomplish practically the same end; and, while it has done much to prove the advisability of encompassing the end of the root with a band, and to a great extent made possible the ultimate success of permanent stationary bridgework, its virtues have been most grossly abused in their application to anterior teeth, and through their production in ready-made form, the use of which, in justice to the artistic possibilities within the reach of the modern dentist, cannot be too vigorously condemned.

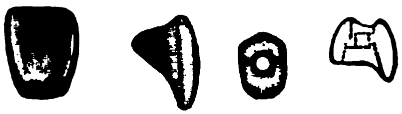

Fig. 7.

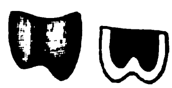

Fig. 8.

The Gates-Bonwill Crown.

As the result of the more or less successful experiment with the Foster and Mack crowns, an improvement subsequently appeared in a tooth that became known as the Gates-Bonwill crown, a patent having been issued to Dr. W. H. Gates in 1875, and to Dr. W. G. A. Bonwill in 1881, covering practically the same ideas.

This crown was of porcelain, constructed with a concave instead of a flat base, and having a triangular perforation through the body of the porcelain, afforded a better and more secure means of attachment to the root, to which it was secured by means of a metal dowel which was threaded and screwed into the canal, after which the crown was anchored with amalgam. Fig. 7.

The Howland-Perry Crown.

Shortly after this the Howland crown, subsequently modified by Dr. S. G. Perry, and styled the Howland-Perry crown, was suggested. This was very similar to the preceding ones, but differed, like the Mack crown, in that the accommodation for the dowel was confined to a cavity in the body of the porcelain, instead of passing entirely through it. This followed the then developing tendency toward the

esthetic, by the preservation of the continuity of the exposed surfaces of porcelain, not disclosing the end of the metal dowel or the mounting material. Fig. 8.

The Richmond Crown.

This design was patented by Dr. C. M. Richmond in 1880, and consisted of a cap encompassing the end of the root, to which a facing similar to the ordinary plate tooth was attached by soldering. This was the first practical application of a band to a root for anterior crowns with porcelain facings.

As originally designed, it consisted of a band, to which was soldered a floor, forming a cap. To this was then attached a facing hollowed out between the pins so as to accommodate a threaded dowel which, passing

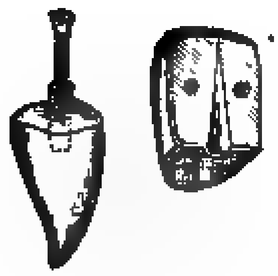

Fig. 9.

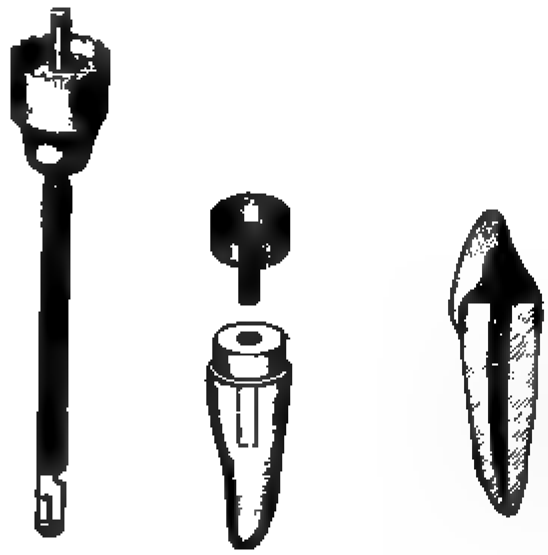

Fig. 10.

through the cap, was then screwed into a tube previously mounted in the canal, thus attaching the crown to the root. Fig. 9.

While it was then for some time a matter of doubt and conjecture as to the advisability of banding the anterior teeth, and as to whether it was an objectionable or an advantageous procedure, the original principle was soon abandoned because of the intricate and unstable manner of attachment, and the apparent uselessness of a separate dowel, but the modifications and improvements resulting from this suggestion are now conceded to be the best means of securing permanence in the operation, and are the accepted practice of today.

The Büttner Crown.

During the early agitation of the feasibility of banding, Dr. H. W. Büttner invented a metal and porcelain crown with a band wherein the method employed in attaching it to the root would possess the advantages of a band, and at the same time preclude its possible irritating influences.

This was accomplished by trephining the periphery of the end of the root to form suitable accommodation for the band, with instruments specially devised for the purpose, but the idea never met with universal favor, and it was soon abandoned. Fig. 10.

The How Crown.

A crown devised by Dr. W. S. How in 1883 consisted of a thin facing with four pins and a slotted back for the reception of the "screw-post," which was anchored to the facing by bending the pins over it after it was backed up, and the desired contour was then built up with solder. The extreme thinness and consequent weakness of the porcelain rendered its usefulness limited. Fig. 11.

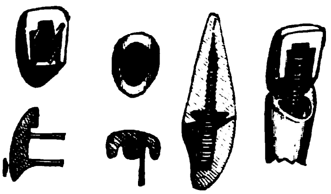

Fig. 11.

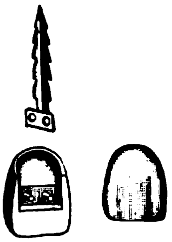

Fig. 12.

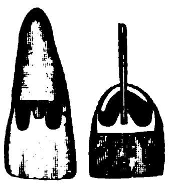

Fig. 13.

The Weston Crown.

Another similar form was invented by Dr. Henry Weston in 1883 and subsequently modified. The first design comprised a means of attaching the dowel to the facing, which is best described by the illustration, after which it was attached to the root. Fig. 12.

In the modification the dowel was first securely fixed in the root and then the crown which was constructed with a view of being much stronger, was held in contact with the root, and anchored by packing through an opening for the purpose, on the lingual surface. Fig. 13.

It will be observed that up to this time the various steps in the development of the work consisted of a crown and dowel as two separate parts, but here a deviation in the principle was made for the purpose of securing additional strength, in which the dowel became an integral part of the crown by being baked in the body of the porcelain.

The Logan Crown.

This crown the first to be so constructed, was the invention of Dr. M. L. Logan, patented in 1885, and made with a large body of porcelain having a concave countersunk base to facilitate adaptation to root, and a dowel shaped more in line with scientific principles. More nearly approaching

the requirements in conformation than any of its predecessors, it soon became very popular, eventually supplanting all other designs of similar nature, and for years has had an extensive use and application. Fig. 14.

The Brown Crown. Another design was shortly afterward evolved and introduced by Dr. E. Parmley Brown, and while of the same type, it possessed a base convex, instead of concave, with a view of affording by means of its construction, the greatest possible strength at the seam of union between crown and dowel, and crown and root.

Its adaptation to the root after cutting it down properly was made by using a bur which produced a concavity, to accommodate the convexity of the base of the crown; but the increased strength of the crown being secured at the expense of the root, soon resulted in its abandonment. Fig. 15.

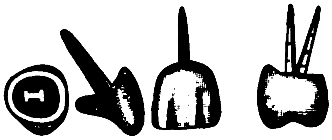

Fig. 14.

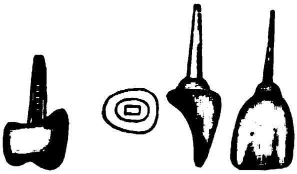

Fig. 15.

Fig. 16.

The Webb Crown. The difficulty of grinding one surface to closely approximate another, and the conceded advantages of a close union between crown and root, soon stimulated a desire to secure better adaptation, and resulted in the suggestion of a plate and dowel crown probably first used by Dr. M. H. Webb.

This was constructed by swaging or burnishing a metal plate to the end of the root, then perforating it to admit of inserting into the canal a dowel, which was soldered to the plate, to which the facing was then attached. The possibilities of adaptation and its advantages have become so recognized that many still so construct their crowns, and they are frequently indicated. Fig. 16.

Soon, however, the advancement of the profession along those lines leading to the achievement of the very highest conceptions of art, indicated a tendency to observe the maxim "true art is to conceal art," and created a desire for something that might supersede the use and display of gold, something more nearly resembling and harmonizing with nature, yet, still serving the same purposes. Even in this the inventive genius of the profession was not long in again asserting itself, and soon afterward came the application of vitrified porcelain.

The first suggestions were perhaps made by Dr. C. H. Land, and were eagerly studied and enthusiastically applied with varying degrees of success and failure. Dentures of platinum and porcelain had been constructed and worn successfully for years, hence it was readily believed that crowns and bridges of the same must also of necessity be equally successful. In this, however, many were doomed to disappointment, and because of inadequate knowledge of the requirements, too much confidence, and the over-zealous enthusiasm of early advocates, its use and practicability soon became questionable, and was eventually discontinued by the great majority.

There were those, however, who, still admiring its esthetic beauties, and having faith in its possibilities, sought to ascertain the causes of failures, and the reasons for success, with the result that its more recent and modern application has approached and made possible the very highest degree of perfection in dental art and prosthesis. Yet it is not universally applicable, and will never supersede the use of gold. The success of each must always depend in a great measure upon the sound reasoning, good judgment and skilful execution and discrimination with which they are respectively applied.

It will be observed that, from the very beginning, the innate and intuitive desire for the practical and esthetic development of this work to more perfectly meet the demands and requirements of the times, has resulted in the presentation of many varied principles and methods, among which may be also included the jacket crowns; the application of porcelain facings to shell or telescope crowns; the Logan crown with the addition of a band; the various modifications of the porcelain crown with separate dowel, such as the Davis crown, the intradental band and similar designs, and a galaxy of other varying and ingenious ideas. Yet they are in the main but modifications of the original principles enumerated, and, while aiding materially in the evolution, and showing the trend of the development and progress of crown work from its inception, their individual description would be redundant and unnecessary.

Those of practical value, use and application at the present time can be treated to better advantage elsewhere than in a brief résumé of the development and history of this work, which is intended only to show the perseverance and ingenuity of our predecessors, and the various steps in making possible the success of modern crown work, for which their efforts were primarily responsible.

Metals, Alloys and Solders.

CHAPTER II.

Symbol and Fusing Point of Metals Used. Noble and Base Metals. Chemical and Physical Properties: Chemical Action, Color, Odor and Taste, Fusibility, Malleability, Ductility, Tenacity. Physical Processes: Soldering, Welding, Annealing, Tempering, Alloying, Troy Weight. Consideration of the Metals: Gold, Karat, Platinum, Iridium. Alloys: Alloys of Gold, Coin Gold, Gold and Platinum, Platinized Gold. Solders: Platinum Solder, Gold Solders, Compounding Solders, Brass, Dorrance's Alloy, Silver Solder, German Silver, Fusible Alloys, Soft Solder, Refining Gold, Etc.

One of the first essential duties incident to the successful execution of any line of work in art or mechanics is a thorough practical knowledge of the materials used; hence, in the construction and application of crown and bridge work, wherein the use and manipulation of the metals and their combinations forms such an important feature, it is materially necessary that the dentist should be acquainted with their characteristics, physical properties and methods of manipulation.

This is imperative only that he may the better understand their application, for it no longer becomes necessary for him to be an expert metallurgist, to refine or alloy, prepare or roll his plate material, or to combine and make his solders, alloys, etc., since the manufacturers and supply houses now furnish them in all grades desired; yet a practical knowledge of the methods and detail of manipulating them serves to cultivate and make possible their more skilful application.

Of the fifty-two metallic elements known to, and so classified in chemistry, but a few of them in their metallic form are used in the mechanics and arts pertaining to dentistry; hence, in this connection it is

only necessary to refer to or consider those the physical properties and characteristics of which are of common use and application for practical purposes, and which are contained in the following table:

Name.	Symbol.	Fusing Point.	
		Fah.	Cent.
1. Gold.	Au.	2016	1102
2. Platinum.	Pt.	3632	2000
3. Iridium.	Ir.	More refractory than Pt.	
4. Copper.	Cu.	1996	1091
5. Silver.	Ag.	1873	1023
6. Zinc.	Zn.	773	412
7. Lead.	Pb.	617	326
8. Tin.	Sn.	442	228
9. Bismuth.	Bi.	507	264
10. Cadmium.	Cd.	442	228
11. Antimony.	Sb.	842	450
12. Aluminum.	Al.	1292	700
13. Iron.	Fe.	3000	1600
14. Nickel.	Ni.	3000	1600

Classification.

Noble and Base Metals.

Metallurgy divides the metals into two groups known as the *noble* and the *base,* so classified because of their affinity for and property of combining with oxygen.

The former, having less affinity, do not so readily combine with it by absorption from the atmosphere, and are more easily separated from its combination when subjected to heat; while the latter, having a greater affinity, and absorbing it more readily, are separated with much more difficulty because their compounds are not decomposed by heat alone.

Noble Metals.	Base Metals.	
Gold.	Copper.	Cadmium.
Silver.	Tin.	Antimony.
Platinum.	Zinc.	Aluminum.
Iridium.	Lead.	Iron.
	Bismuth.	Nickel.

Chemical and Physical Properties.

While all metals possess distinct individual properties characteristic of themselves, it becomes necessary for us to consider only those of such practical importance as render them useful and applicable to our purposes.

Chemical Action. While all metals are more or less susceptible to the action of the secretions of the mouth, gold and platinum are the least so, and of these two platinum always withstands this influence and retains its color much better than gold, which is due mainly to the fact that platinum is commonly used in the pure state, and gold in the alloyed state.

Color. Each metal possesses a characteristic color, varying from the grayish-white of silver and platinum to the muddy blue of lead; and from the rich bright yellow gold to the dark red of copper; each of which is always modified more or less by alloying.

Gold and platinum, however, possess a metallic lustre and colors which are in contrast more pleasing to the eye, and more in harmony with surroundings, and which are the least susceptible to change by the chemical action of the secretions.

Odor and Taste. Odor and taste are possessed by most metals to such an infinitesimal extent that it is almost unnecessary to mention them. Copper and zinc, however, have the most definite metallic odor and taste, but as this is apparent only when they are subjected to a temperature higher than that of the body, and they are used only for the purpose of alloying, the characteristic is of no especial importance.

Fusibility. All metals are capable of being reduced to a liquid state under the influence of heat, but the melting point or degree of fusibility differs greatly, and, like the color, is modified by alloying. The practical infusibility of platinum of any thickness greatly facilitates some classes of work, and the controlling at will of the fusing point of gold by alloying makes the assemblage of innumerable parts and the art of soldering a comparatively easy and simple matter.

Malleability. Malleability is the inherent property of a metal which admits of its being hammered or rolled into thin sheets wthout destroying the continuity of its surface, and permits of its easy manipulation and adaptation.

Ductility. Ductility is the property which admits of being drawn out into lengths of a small diameter, such as wire.

Tenacity. Tenacity is the property of molecular resistance to tension, upon which depends the strength of the metal.

In studying the accompanying table, it will be noted that gold, while ranking first of the five principal metals most commonly used, in malleability and ductility, ranks last in tenacity, but this, of course, refers to pure gold, the tensile strength of which is greatly increased by alloying with copper, silver or platinum.

	Malleability.	Ductility.	Tenacity.
Rank I.	Gold.	Gold.	Iron.
" II.	Silver.	Silver.	Copper.
" III.	Copper.	Platinum.	Platinum.
" IV.	Platinum.	Iron.	Silver.
" V.	Iron.	Copper.	Gold.

Physical Processes.

The physical processes which mostly concern the dentist in the manipulation of the metals to accomplish the necessary and desired physical changes are those of soldering, welding, annealing, tempering, and alloying, and a clear conception of each is of infinite importance in their use.

Soldering. Soldering is the process of uniting surfaces of metal by fusion or superficial alloying.

Welding. Welding is the process of uniting surfaces of metal by molecular attraction under heat and pressure.

Annealing. Annealing is the process of softening or securing increasd malleability, and as all metals expand under the influence of heat, they in turn become softened because of the separation of the molecules produced by this expansion.

To accomplish this, they should be slowly heated to a cherry-red and allowed to cool gradually, though plunging gold into water or alcohol does not interfere with, and the latter seems to even increase its softness, while aluminum, fusing at a cherry-red heat, is best annealed by coating each surface with oil, then igniting same and allowing it to burn off.

Tempering. Tempering is the process of hardening. In gold, platinum, silver, copper, etc., it obtains as the result of manipulation and consecutive working, due to a molecular condensation; while in iron containing carbon (steel) sudden thermal changes from various degrees of heat produce hardness in

proportion to the quantity of carbon present, and the manner and method of cooling; while in some alloys the reverse condition obtains.

The accompanying table is indicative of the heat and color necessary in tempering the various kinds of instruments used. (Essig: Am. Text book, Pros. Dent., p. 131.)

Temperature.	Color.	Use.
430 to 450 Fah.	Light yellow.	Enamel chisels.
470 Fah.	Med. "	Excavators.
490 Fah.	Brown "	Pluggers.
510 Fah.	" purple.	Saws, etc.
520 Fah.	Purple.	Wood-cutting tools.
530 to 570 Fah.	Blue.	Clamps, etc., when elasticity is desired.

Alloying. As alloys are a combination of two or more metals, alloying is, of course, the process of combining metals, and is of material significance because so few are now used in their pure state. Most metals enter freely into combination with others, the alloy resulting frequently possessing characteristics entirely different from those of any one of the component parts.

They always fuse lower than the highest fusing, and often lower than the most easily fusible, and in compounding them the least fusible should usually be melted first in a clean crucible, and the others added in relation to and in accordance with their fusibility, after first carefully weighing out the proper proportions.

Alloys of gold, copper and silver can be melted and incorporated almost simultaneously with comparative ease, while those containing platinum or zinc are more difficult. The former is usually added by feeding it into the molten mass in thin, ribbon or foil form, while the latter is best incorporated in the shape of brass or some other alloy of known formula, because of the rapid volatilization of the metal. When zinc is to be added in the pure state, the proper quantity should be weighed, broken into small pieces and each piece coated with a film of paraffin or wax, then quickly carried into the molten mass with pliers.

In this work it is necessary that one should be familiar with the table of weight used for the purpose.

Troy Weight.

24 grains (gr.)	=	1 pennyweight (dwt.).
20 pennyweight (dwt.)	=	1 ounce (oz.).
12 ounces (oz.)	=	1 pound (lb.).

Scale.

lb.	oz.	dwt.	gr.
1 =	12 =	240 =	5760
	1 =	20 =	480
		1 =	24

Consideration of the Metals.

Gold. The color, malleability, compatibility, slight susceptibility to the chemical influences of the secretions and other qualities possessed by gold make it easily the nearest approach to the ideal for universal use, and while the higher artistic and esthetic tendency should always be to avoid its conspicuous display in the mouth as much as possible, its sphere of usefulness is unlimited.

Owing to its extreme softness in the pure or unalloyed state, however, it must be combined with other metals which will impart, to a desired degree, the stiffness and strength necessary to withstand the stress and wear imposed, without appreciably affecting its other qualities, and the ease with which it may be thus alloyed greatly enhances its value.

In prosthetics the use of gold in the pure form is necessarily limited, being usually confined to work where a perfect adaptation is indicated, such as backings for porcelain facings, individual bands, etc., where it is to be afterward reinforced, and also as a solder for platinum work.

Karat. In alloying gold the term karat is applied to the degree of fineness, and designates the proportion of pure gold to the ratio of 24 parts. Thus 24 K. is virgin pure, while 18 K. is composed of 18 parts of gold and 6 of alloy.

Platinum. Platinum is rapidly acquiring an extensive sphere of usefulness in dental art, and because of its many admirable physical properties is second only to gold. Those of malleability and practical infusibility render its manipulation more or less easy, and have made possible the success of porcelain work in the various phases of its present application; and it withstands the chemical action of the secretions so much better than gold as to rank first in compatibility with the tissues, which take most kindly to it. It is also used extensively in alloying gold to which it imparts special properties.

Iridium. The use of iridium, the physical properties of which resemble, but are more refractory than platinum, is confined to alloying with the latter, the combination forming a tougher, harder metal, such as is indicated in post material for dowel crowns and other instances requiring more than ordinary strength.

Alloys.

Alloys of Gold. For the purpose of reducing the fineness and increasing the strength of gold, copper and silver are mainly used as the alloy, usually in the proportion of two parts of copper to one of silver. The former imparts hardness and elasticity, and the latter pliability and strength, together with a preservation of the original color which copper alone would change, except where the desired fineness of the gold after alloying would not admit of sufficient proportions of same to possess the requisite strength, when platinum is added in small proportions to secure this result.

For crown and bridge work, where strength and good color should be combined and are prerequisites, the gold most generally used to the best advantage is of about 22 K. fineness, which is necessary to resist or secure immunity from the chemical action of the secretions, retain its color and luster and withstand the stress; and is used in plate varying from 28 to 30 U. S. Standard Gauge.

The following are three common formulæ used for this purpose:

No. 1.	22 K.	No. 2.	21.6 K.	No. 3.	21.6 K.
Pure gold,	22 dwt.	Pure gold,	90 parts.	Coin gold,	50 parts.
" copper,	1 "	" copper,	5 "	Pure "	45 "
" silver,	18 gr.	" silver,	5 "	" silver,	5 "
Platinum,	6 gr.				

Coin Gold. The United States coinage, gold, 90; copper, 10, was for many years the means of furnishing plate which was used exclusively, but which is not employed so extensively now because of the extreme hardness of gold alloyed with copper alone, and of the objectionable reddish color, which is not so pleasing to the eye, especially when contrasted by proximity with the bright yellow of a pure gold filling. It may be used to good advantage, however, in combination with pure gold and silver in proper proportions, because of the definite knowledge of the proportion of copper contained.

Gold and Platinum.

Gold and platinum alloy is indicated wherever additional strength and springy elasticity are desired, such as clasps, and for stiffening the work over parts which will be subjected to more than ordinary stress, which property the addition of platinum, one part in 24, imparts to the alloy. The following formula is used for the purpose:

Pure gold,	20 parts.
Pure copper,	2 "
Pure silver,	1 part.
Platinum,	1 "

Platinized Gold.

Platinized gold is a form of plate made by fusing pure gold over one surface of platinum, which upon being passed through the rollers then presents a smooth, unbroken surface of each metal. It is much used in gold work where infusibility seems desirable, and the presentation of a surface of gold preferable to that of platinum. It is also frequently useful as a backing for porcelain facings because of the advantage of controlling or preserving the color by placing next to the porcelain whichever surface may cause the least, or produce the most desirable change.

Solders.

Platinum Solder.

The advent of porcelain work and the use of high fusing "bodies" has created a demand for a solder more infusible than pure gold, which was previously used for the purpose, in order that joints so made would not be affected by the high degree of heat necessary to fuse or vitrify the body.

If there is absolute contact of the parts to be united, pure gold can be successfully used, because if thoroughly and sufficiently fused, it becomes an integral part of the platinum by alloying with it; but in extensive work platinum solders are an advantage because of overcoming the possibility of a change in the relation of the parts, caused by the shrinkage of the porcelain, which is considerable.

Such solders are now prepared for the purpose, ranging from 10 to 40 per cent of platinum in combination with gold, but less than 20 per cent is of no advantage, and more than 25 per cent is unnecessary. They may be easily compounded by thoroughly fusing the gold and then feeding into the molten mass the desired proportion of platinum in foil or ribbon form, after which it should be hammered out and remelted several times to insure a thorough admixture.

Gold Solders.

Gold solders are alloys of gold so compounded as to fuse slightly lower than plate of the same fineness or karat; should be composed of the same metals to preserve a close resemblance in color, and differ only in the incorporation of a metal which will reduce the fusing point and impart flowing properties. Thus a 20 K. solder, for instance, should fuse readily on plate of the same K., otherwise it would not be a solder in the sense of the meaning.

Zinc is mostly used for the purpose of reducing the fusibility and imparting the requisite flowing properties, but should not be in proportion more than 1½ to 2 parts in 24; because if in greater quantity the alloy would be rendered brittle, the strength thus diminished, and the susceptibility to chemical influences when exposed to the action of the secretions increased. Solder of a lower K. than is absolutely necessary should never be used, because the lower the K., the greater the affinity for oxidation and the susceptibility to chemical action; and in consequence the seam of union and the surface exposed are always rendered more or less conspicuous; hence it is desirable to begin with as high a karat as possible, so that subsequent solderings may be made with those of a degree of fineness which will aid in precluding this tendency. And as the grades which are prepared for our use invariably run lower than the karat stamp upon them, those of so-called 16 and 14 karat have but a very limited sphere of usefulness.

The following formulæ give the average composition of the various grades of dental solders:

22 K. Solder.

Pure gold,	22 dwt.
Brass,	2 "

Coin Solder.

Coin gold,	5 dwt.
Brass,	1 "

20 K. Solder.

Pure gold,	20 dwt.
Dorrance's alloy,	4 "

18 K. Solder.

Pure gold,	18 dwt.
" silver,	3 "
" copper,	1 "
Brass,	2 "

16 K. Solder.

Pure gold,	11 dwt.,	12 gr.
" silver,	3 "	
" copper,	1 "	12 gr.
" zinc,		12 gr.

14 K. Solder.

Pure gold,	14 dwt.	
" silver,	5 "	
" copper,	3 "	12 gr.
" zinc,	1 "	12 gr.

Compounding Solders. As most of the scrap gold must of necessity be of uniform karat or degree of fineness for the reasons previously mentioned, and because of the ease of securing the various karats of plate and solder by the dentist, it is scarcely necessary to observe or be familiar with the method of ascertaining and computing the fineness of gold to any extent, but as it may often be desirable to compound solders it is well to know the method of reducing scrap to the various karats used.

The following simple rule will enable anyone to reduce a given quality of scrap to any desired fineness of solder.

Rule. Multiply the weight of gold by the karat and divide by the *desired* karat. The difference between the answer after dividing, and the original quantity of gold, is the quantity of alloy necessary to be added.

Example. Reduce 4 dwt., 3 gr., 22 K. gold to 18 K. solder.

4 dwt. + 3 gr. (original quantity) = gr. 99.
99 × 22 (original karat) = 2178.
2178 ÷ 18 (desired karat) = 121.
121 — 99 (dif. bet. result and orig. quantity) = 22.
Ans.: 22 gr. of alloy should be added.

For this purpose the alloy should of course contain copper, silver and zinc, and may be secured in the most convenient form in the shape of known formulæ, such as brass, Dorrance's alloy, or silver solder.

Brass. Brass is composed of copper and zinc in proportions suitable for the purpose intended, usually varying from equal parts of each to 70 of copper and 30 of zinc, and owing to its close resemblance to gold in physical properties and characteristics is much used in various lines of work. When used as an alloy for gold in compounding solders, its definite formula should of course be ascertained, and that composed of copper 50, zinc 50, is the best for the purpose.

Dorrance's Alloy. Dorrance's alloy, suggested by Dr. W. H. Dorrance, is used extensively in reducing gold to solders, being a combination of the three principal metals used, in good proportions, with copper in the preponderance. The following is the formula:

Copper, 6 parts.
Silver, 2 "
Zinc, 4 "

Silver Solder. Silver solder is an alloy of copper, silver and zinc, with silver in the greatest proportion, and is much used in the making of gold solders, as the alloy, as well as being an economical hard solder for various lines of work where brass and German silver are used. A common formula is:

Silver,	6	parts.
Copper,	3	"
Zinc,	1	part.

German Silver. German silver is used to some extent in temporary work of all kinds, such as dowels for temporary crowns and bands for matrices, etc. It is composed of copper and zinc, with the addition of nickel, which increases the fusing point and gives a harder, tougher alloy.

The following formula is much used:

Copper,	50	parts.
Zinc,	30	"
Nickel,	20	"

Fusible Alloys. Fusible alloys are those in which the lower fusing metals are combined, such as lead, tin, bismuth, antimony, and cadmium, and are intended for use in making dies and counterdies for swaging in crown-work, and for the purpose of obtaining models direct from plaster impressions, or from the mouldine compounds suggested by Dr. George W. Mellotte, and composed of potter's clay and glycerine. The extreme fusibility of these alloys depends to a great extent upon the proportion of bismuth incorporated, and varies accordingly. The following are formulæ of the various known alloys of this nature:

Wood's Alloy.

Bismuth,	5
Lead,	4
Tin,	2
Cadmium,	1

Fusing point, 140° F.

Newton's Alloy.

Bismuth,	8
Lead,	5
Tin,	3

Fusing point, 200° F.

Rose's Alloy.

Bismuth,	8
Lead,	8
Tin,	3

Fusing point, 174° F.

Hodgen's Alloy.

Bismuth,	8
Lead,	5
Tin,	3
Antimony,	2

Fusing point, 224° F.

Mellotte's Alloy.		Ordinary Formula.	
Bismuth,	8	Lead,	1
Tin,	5	Tin,	1
Lead,	3	Bismuth,	2
		Fusing point, 200° F.	

R. C. Brophy's Alloy.		Crouse's Alloy.	
Bismuth,	3	Bismuth,	8
Lead,	2¾	Lead,	5
Tin,	2½	Tin,	5
Fusing point, 240° F.		Cadmium,	1
		Fusing point, 190° F.	

Molyneaux's Alloy.	
Lead,	3
Tin,	2
Cadmium,	2
Bismuth,	5
Fusing point, 140° F.	

The lower fusing* of these various well-known alloys may be cast directly into plaster, gutta percha or modeling compound impressions, without waiting for them to dry out, and Dr. Grant Molyneaux recommends that such impressions should be dipped in water just before pouring with his alloy to secure the best results.

Soft Solder. While there is probably but a very limited use for soft solder, it may sometimes be indicated in temporary work. The ordinary tinner's solder is composed of equal parts of tin and lead, though any of the fusible alloys will answer the purpose equally as well.

Refining Gold. It frequently occurs that the accumulation of scrap gold in the laboratory may become so contaminated with base metals, from contact and from the file, that it could not well be used over again by melting and rolling into plate, which convenience sometimes requires, without being first subjected to some simple process of refining.

When the scrap is composed mostly of a known degree of fineness, this may be quite easily accomplished without resorting to the chemical process, by what is known as the *roasting method.*

This consists of placing the scrap in a clean crucible with plenty of borax, and applying heat until a perfect fusion is reached, when small pieces of potassium nitrate (saltpetre) should be consecutively added.

This oxidizing agent furnishes usually sufficient oxygen to oxidize all base metals, which oxides are absorbed by the borax, and if kept up long enough will result in so materially refining the gold as to permit of its being annealed, rolled to the desired thickness and used over again.

Recovering and Refining Waste Gold.

While it is very probable that the average dentist will have neither the time, inclination nor facilities for recovering the waste gold which daily finds lodgment in, or becomes attached to, sweepings, rugs, carpets, disks, strips, etc., yet the method usually employed in obtaining and refining it may be of some general interest.

The sweepings and such various articles as may contain gold are first placed in a suitable vessel, and subjected to a degree of heat in a blast furnace which will reduce them to ashes and residue, after which this latter is then *finely powdered.*

The gold, together with its impurities, can now be separated from most of the ash, carbon, sand, etc., by a mechanical process of *washing,* in which, because of the high specific gravity of the metallic masses, the latter will seek the lowest point, allowing the residue to remain on top.

The gold may now be extracted from the remaining mixture of heavy material by the following method: Treat with nitro-hydrochloric acid (aqua regia), heat gently, agitate occasionally, and then allow the mixture to stand for a few hours.

The solution is now evaporated until all free acid has been expelled, when it is allowed to cool, and alcohol and potassium chloride are added, which precipitates any platinum that may be present.

The gold may now be precipitated from the *filtered* solution by adding ferrous sulphate, c.p., or heating it with a solution of oxalic acid, when the precipitate, a fine brown powder, should be washed with distilled water, placed in a graphite crucible and thoroughly fused with potassium nitrate (saltpetre), or borax, as previously indicated.

The molten metal may be then poured from the crucible into a previously warmed and oiled mould, when an ingot of pure gold is obtained, which may be alloyed, if desired, and rolled out to suitable thickness for use.*

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*The foregoing is intended only as the essence of dental metallurgy, tinctured with practical application in its relation to crown and bridgework. The Author has quoted freely from Mitchell's *Dental Chemistry*, Hodgen's *Dental Metallurgy*, and the *American Textbook of Prosthetic Dentistry*, edited by Dr. C. J. Essig, and is indebted to Dr. J. P. Buckley, of Chicago, for suggestions and assistance

Soldering.

CHAPTER III.

Essential Requirements: Cleanliness; Acid Bath. Flux; Borax; Method of Using, Parr's Fluxed Wax, Liquid Soldering Fluids. Apposition; Requirements and Method of Obtaining. Uniform Heat; Application and Requirements. Difficulties Encountered: "Balling Up," Shrinkage, Base Metals, Gravity, Fracturing Porcelain Facings, Soldering Block Teeth. Manipulation: Soldering Without Investment. Flame Blow-pipes. Soldering With Investment, Gold Soldering, Pure Gold Soldering, Platinum Soldering, Oxy-Hydrogen Blow-pipe, Cooling After Soldering, To Prevent Unsoldering. Sweating Process. Autogenous Soldering. Soft Soldering.

In its application to dentistry soldering has rapidly assumed the significance of an *art* of much greater importance than ever attained by those presupposed past masters—the gold and silversmiths. This is readily proven by the ease with which the process is now executed in the consecutive union of a multiplicity of parts and the building or restoration of contour, as compared with the work along similar lines confined to their province.

The ease and dexterity with which such results may now be obtained by the more skilful, however, compared with the expressions of doubt and even dread manifested by others, followed by such discouraging failures as the burning or fusing of the parts, or the fracturing of porcelain facings, leads to the very natural conclusion that in such instances the lesson has not been properly learned, and that the subject merits and demands more thoughtful consideration and study, and more persevering application than is usually accorded.

To this end the dentist cannot too closely apply himself in the effort to become sufficiently skilled as to render the procedure one of simplicity and ease, together with reducing to a minimum, or eliminating, all attending dangers of and liability to, accident, which in this, the physical

process of uniting surfaces of metal by fusion or superficial alloying, will invariably follow a comprehensive knowledge of the fundamental requirements, and a close observation of all of the essentials concomitant with success.

Essential Requirements.

These important considerations are cleanliness, flux, apposition, and uniform heat, and unless clearly understood from a practical standpoint, the process involved, while perhaps sometimes successfully accomplished, is necessarily followed in a more or less perfunctory manner, in which case the operator becomes simply an automaton.

Cleanliness. The thorough removal of all oxidation and deposits of foreign nature from the surfaces to be united is highly necessary in order that the solder may become thoroughly attached or incorporated, so that the element of strength may be insured in the union. This may be secured by scraping or filing the surfaces, or by treating them with an acid solution.

Acid Bath. For this purpose sulphuric or hydrochloric acid, diluted with an equal proportion of water, is used, into which the parts are immersed for a few moments to dissolve and remove all foreign substances.

Sand Bath. Sulphuric acid is preferable, and for large work should be contained in a porcelain evaporating dish of proper dimensions, as heat materially increases its cleansing properties. The dish should then be placed in a shallow sheet iron bowl partially filled with sand and placed upon a tripod over an alcohol or Bunsen flame, by which means the parts may be boiled, if necessary. As the fumes thus given off are more or less injurious when inhaled, some provision must be made for carrying them away, which may be quite easily accomplished by attaching a hood to a gas pipe and permitting the latter to pass through a hole in the window at some accessible point (Fig. 17).

For small work a much more convenient method is to freshly mix the solution each time by *pouring* into a small quantity of acid an equal proportion of warm water, when the chemical reaction will generate heat enough to thoroughly clean the parts, after which it may be thrown out.

For metal work only, where no porcelain is used, this solution may be saved by placing it in a large-mouthed bottle and used indefinitely and effectively when cold by first heating the parts to be cleaned and then plunging them into the acid.

After removing the work from the bath, it must always be thoroughly washed in clean water to so dilute the acid as to remove all traces

Fig. 17.

of it before heating in the flame, because if this is not carefully done, and any traces of acid should remain, the formation of the salts of the baser metals which is facilitated by the heat will at once preclude the possibility of soldering until again treated with acid and this precaution observed.

Flux.

As the affinity for absorbing oxygen from the atmosphere, which nearly all metals possess, is increased by heat, the application of it incident to the process of soldering causes the exposed surfaces to become rapidly oxidized, in consequence of which it is necessary to preclude the possibility of such tendency and preserve the cleanliness of the parts in order that the solder may not be prevented from readily fusing and becoming alloyed.

Substances are used for this purpose which, when fused over such surfaces, keep them clean and free of oxidization, and aid in the fusing and alloying. It is equally necessary that the solder as well as the surfaces of metal be thus treated, because, being a lower grade alloy, it is more easily oxidized. When not so treated the neglect may not infrequently be the cause of much obstinacy in fusing, demanding a greater degree of heat than otherwise necessary.

Borax.

Borax is most generally used for this purpose and meets the requirements in every respect, but the common practice of using it in dry powdered form, in far greater quantities than necessary, is to be most vigorously condemned, because when first heated it expands to such extent as to not infrequently split the investment and change the relation of the parts; may even flake or deface the porcelain if it should come in contact with it by fusing upon it; always displaces the solder, and usually results in the presentation of a pitted surface.

To prevent this and secure the best results, it should be mixed with clean water to the consistency of a thin paste, and applied, before heating the parts, with a small camel's hair brush, which admits of its application to the particular surfaces in the proper and necessary quantity.

Owing to the tendency to crystalize, however, it is difficult to preserve such consistency, but this may be facilitated by preparing and

Fig. 18.

keeping it in a glass-covered dish, where it may be also kept clean and free from dirt, which is eminently desirable. (Fig. 18.)

Parr's Fluxed Wax.

This is a hard wax, containing an admixture of borax, which is much used, and is a convenient form of flux, as the wax burns out, leaving the borax deposited upon the surfaces in small proportions.

Liquid Soldering Fluid.

Liquid soldering fluid is now being extensively used in dentistry, and has been by jewelers for a number of years, and is the best, cleanest, most desirable and convenient flux for our purpose. It is a saturated solution of equal parts of borax and boric acid in water, and can be more easily and readily applied with a camel's hair brush or small piece of wood in proper quantity to a better advantage than any other.

In *all* instances, however, the flux should be applied before heating the object to be soldered, in order that it may be placed in or carried to every portion and surface of the metal upon which the solder should flow in securing union. This is not always possible if applied to the heated case, in which instance powdered borax is preferable.

Apposition.

To facilitate the union between the parts, the edges or surfaces should always be in absolute contact, or as nearly so as possible, so that there may be strength in the joint, and no impediment offered to the solder in flowing freely over the surfaces to be united.

In case the proper relation necessary to be sustained will not admit of contact, it should then be secured by filling in between such edges or surfaces, thus bridging them over with small pieces of the metal of which the work is being constructed. This is usually best accomplished with gold or platinum wire or plate, or some of the foil or crystal golds, the latter being preferable because of their thickness, which should be fitted or packed into place before the case is heated.

Uniform Heat.

The application and proper manipulation of heat in securing the best results is an important feature, but because of the under-valuation or over-estimation of the requirements is frequently the means of much discouraging and unnecessary labor, yet when properly applied with the former prerequisites observed, the entire procedure is infinitely simple.

In this connection it must be remembered that, as the process constitutes the alloying of the parts, the surfaces to be united *must be freely exposed,* and then brought to a degree of heat exceeding, or at least *equal to, the fusing point of the solder before union can obtain.*

Difficulties Encountered.

If this degree of uniformity is not scrupulously observed, and the heat be directed upon the solder before the parts are equally and sufficiently heated to permit of alloying, the aggravating annoyance of "balling up" is invariably the result.

"Balling Up."

This tendency of the solder to assume globular form with more or less obstinate persistency is due only to the difference between the size of the object to be soldered and the relative degree of heat required by it, as compared with the small quantity of solder used and its consequently greater fusibility. If much time be thus consumed the baser alloy contained in the latter may be burned out, the loss or depletion of which will increase the fusibility and decrease the flowing properties to such extent, perhaps, as not infrequently to cause the melting of the parts.

As this is obvious, and since the affinity of one metal for combining with another is increased by heat, it is only necessary to first raise the temperature of the higher fusing parts equal or near to the melting

point of the most fusible, when very little further heat well directed upon both simultaneously will result in perfect union with little or no effort, and as the *solder will follow the heat* or flow in the direction of the greatest degree of temperature, it can be controlled accordingly.

Shrinkage. As the shrinkage of solder increases in proportion to the quantity of baser alloy incorporated, and manifests itself to such an appreciable extent in gold work, it is imperative to use the utmost precautions toward preventing the possible change in the relation of the parts which might thus ensue, and which may not infrequently result in jeopardizing the fit and adaptation.

To preclude this possibility it is necessary to observe the requirements of apposition and contact very closely, and in more or less extensive work it may be further prevented by soldering each piece separately first so that in the final assemblage of the parts as little solder may be used and carried to the fluid state as is immediately required to secure union and strength. Thus very large cases should be soldered in sections and afterward united.

Fracturing of Porcelain Facings. Perhaps paramount among the difficulties most frequently experienced is the checking or fracturing of porcelain facings, but this, while seemingly and apparently unavoidable, is in nearly all instances due to the most flagrant *negligence*, in so far as soldering is concerned.

In this connection it is necessary to consider the fact that a porcelain facing constitutes and presents two distinct substances, the mineral and the metal—the porcelain and the pins—each of which possesses physical properties which are affected very differently by the heat to which they are subjected.

The mineral, absorbing heat very slowly and gradually, retains it for a considerable length of time, while the metal absorbs it readily, and gives it off or cools with equal rapidity; consequently, in the process of soldering, the utmost care must be exercised in applying the heat so gradually and uniformly from the very outset that the porcelain, which is a friable material, will receive it either preceding or at least simultaneously with the platinum pins, in order that the expansion which takes place in each may occur evenly and uniformly. It is invariably this *uneven expansion,* wherein that of the porcelain is not sufficient to accommodate that of the pins, which causes the fractures occurring across the surface of the facing, always radiating from the pins. To various other reasons, however, may sometimes be attributed this difficulty, but the percentage is very small as compared with that of uneven expansion.

Such other cases may be from *impingement* due to the shrinkage of the solder and augmented by too close proximity of parts with each other to accommodate this shrinkage, from overhanging edges of backings, which in contracting necessarily impinge upon the edges of the facings, causing innumerable small checks along such edges; to perforating the backings with openings much too large for the reception of the pins, thus permitting the solder to run in between backing and facing; or to carelessness in bending the pins (to retain the backings), in such manner as to produce a constant strain on the porcelain immediately surrounding their attachment. As a proof that it is either uneven expansion or faulty adaptation of the backing, it is noticeable that facings seldom if ever check in porcelain work where they are subjected to even a much higher degree of heat.

Soldering Block Teeth.

Where there has been extensive resorption of tissue it will sometimes be desirable to use what are known as gum blocks. Because of the curve of these blocks there would be more or less liability of fracture, even in skilful hands were a single backing to be used for the whole block. By a very simple method, however, blocks of three and even four or more teeth may be safely utilized, thus avoiding the unsightliness and uncleanliness of joints which would result from using single gum teeth. This absence of joints is especially desirable when restoring the anterior upper teeth, and in replacing the four incisors a most artistic result may often be attained with a single gum block. In using these blocks each tooth in the block should be backed separately, the backings being so placed that they would not absolutely touch. In adapting the blocks to the piece to which they are to be attached, care should be employed to so fit them that the minimum of solder will be required to effect union. There will be no danger of cracking the block during this last procedure, because the base to which attachment is made should afford ample resistance to the slight shrinkage of the solder at the bases of the separate backings.

Base Metals.

Another not unusual occurrence, during the process of soldering is the appearance of small holes or perforations on the surface of the metal. These are usually due to the presence of some of the baser metals, which may become attached by contact with the dies in swaging; from a file containing same, or from the work bench, and can only be avoided by always carefully treating the piece to an acid bath immediately *preceding* each application of heat.

Gravity

In extensive work it is always desirable to observe the laws of gravity as much as possible, for while it is true that the solder will follow the heat, and its flowing may be so controlled in a measure, when used in considerable proportion its weight will naturally cause it to seek the lowest point, hence it frequently becomes necessary, especially in large cases for the anterior part of the mouth, where the curvature is greater, to change the position of the case as the soldering progresses in order to retain the mass in the desired location when in the fluid state.

Manipulation.

Closely following a consideration of the requirements and difficulties encountered in this work is the importance of practical manipulation in its various phases, the proper execution of which renders the procedure easy and simple.

Soldering Without Investment.

In soldering bands, caps, and cusps, where no investment is necessary to sustain the relation of the parts, the work is more easily accomplished because of the greater opportunities for securing uniformity of heat, and can usually be done in the flame of an alcohol lamp or Bunsen burner with ease; but the manner of holding the object in the flame, and the material of which the instruments for the purpose are made bear materially upon the dexterity and simplicity with which the procedure may be accomplished.

Flame.

As different parts of the flame vary in the degree of intensity of heat, it is of importance that the object be held in a proper relation to the same in order that the soldering may be more easily accomplished. The flame consists of an outer sheath varying in color from a dark blue at the base to a yellowish white at the point, which envelopes a central cone of light bluish color, at the summit of which the greatest degree of heat is present (Fig. 19).

Fine-pointed pliers should invariably be used and the object should be held at a point as remote from the surface to be soldered as possible, so that the pliers will not absorb the heat. Because of this tendency, steel instruments should seldom be used, while those made of nickel, or its alloy, or of steel with fine platinum points answer the purpose much better because they absorb so little heat that they may be held comfortably in the hand.

In soldering platinum with pure gold the use of flux is not imperative, for the reason that both metals are pure and devoid of alloy, which

greatly diminishes their susceptibility to oxidation, and the ordinary mouth blowpipe (Fig. 20) is all that is necessary; while platinum solder up to twenty-five per cent. can be successfully used with the "combination" blowpipe and bellows (or compressed air) (Fig. 21) or may be

Fig. 19.

equally well done with the gasoline blowpipe, a successful and convenient style of which includes a burner and is manufactured by Dr. R. C. Brophy, of Chicago, Ill. (Fig 22), or small pieces of platinum work where the contact and relation can be sustained by proper adjustment, and where

Fig. 20.

no investment is necessary, can very often be soldered in the electric furnace with much convenience.

Soldering With Investment.

Where the case is necessarily invested the process is usually considered as a somewhat more difficult and arduous task, which for very good reasons it unfortunately often proves to be, the principal one of which is a failure to properly and adequately heat the entire case *before attempting to solder.*

It should first always be placed upon a Bunsen or gasoline burner and allowed to remain sufficiently long to become gradually and thoroughly heated, which may be hastened, if necessary, by applying and di-

Fig. 22.

recting the heat with the "brush" flame from the blowpipe, to the under surface in conjunction with the burner. Then when it shall have reached a temperature indicated by a red heat, the solder should be consecutively

applied in *fairly good sized pieces,* which, with the burner from beneath to preserve a uniform heat, and a "pointed" flame from the blowpipe directed upon the parts, will easily and quickly accomplish the object sought without useless expenditure of effort or energy.

The fusing and flowing of the solder in the desired location and direction may be facilitated by using the point of an ordinary slate-pencil when in the partially fused or plastic state, after which only heat sufficient to solidify the mass until a smooth surface obtains should be applied.

Gold Soldering.

In fusing gold solder of any grade the requirements in the degree of heat so far as the blowpipe itself is concerned are generally greatly overestimated. If the case is first properly heated, the combination blowpipe controlled by the mouth easily furnishes all that is necessary, and is preferable and safer, as the danger attending the burning of the parts is always increased by the use of the bellows, because the control is not so perfect.

To blow a continuous flame with the mouth blowpipe is a valuable accomplishment and can be acquired with practice by nearly anyone.

Pure Gold Soldering.

In platinum work, where the danger of burning is eliminated, and the requirements of heat are increased by the use of pure gold as a solder, the bellows will, of course, be found convenient and useful, though even then the skilful manipulation of the mouth blowpipe will accomplish the work. However it may be obtained, heat enough to *thoroughly fuse the gold until it becomes alloyed with the platinum,* so as to occupy no apparent space except that in the immediate joint, is absolutely essential to successful results in this work.

Platinum Soldering.

In small cases where a large investment is not indicated, platinum solders up to twenty-five per cent. may be fused with the bellows or compressed air, but the necessary degree of heat to thoroughly and easily fuse them can, of course, be best obtained from the oxy-hydrogen flame, which is indicated always in extensive work.

Oxy-Hydrogen Blowpipe.

The use of an oxy-hydrogen blowpipe is regarded by many as being somewhat complex and expensive, but is in reality most simple and comparatively inexpensive. In manipulating one the illuminating gas should be turned on first and ignited, and then the nitrous oxide valve opened very slowly and gradually, until perfect combustion is obtained. The case should be first thoroughly heated with the *brush* part of the flame after which it is necessary to bring the point of the central *cone*

in contact with the surfaces to be united, as this is the heat-producing portion. The soldering may then be accomplished with ease.

The extreme heat and incandescence, however, is very trying to the eyes, and a pair of smoked glasses will be found most conducive to success and comfort. Fig. 23 illustrates a simple and inexpensive apparatus for this work, manufactured by L. J. Mason & Co., of Chicago, Illinois.

Cooling After Soldering.

When the soldering has been completed, the case should remain over the flame for a few moments to prevent too rapid cooling and the consequent sudden contraction or shrinkage, after which the flame may be turned off and the case allowed to stand until cool enough

Fig. 23.

to handle, when it may be then removed from the investment, cleaned in acid, and finished.

To Prevent Unsoldering.

In cases where an investment is not indicated it is frequently desirable to observe some precautions to avoid the unsoldering or re-fusing of parts previously united, which is usually accomplished by the mere presence of the investment itself when such is used. This may always be very easily prevented by coating or treating such surfaces with crocus (ferric hydrate), or a liquid solution of whiting, or plumbago, in water or alcohol.

Sweating Process.

The not infrequent occurrence or presence of small perforations in the surface of the work makes it often necessary to resort to some means of filling them in. This is best accomplished usually by what is known as the sweating process, which simply implies bridging them over with solder.

This may apply to cases requiring investment or not, and the procedure in either instance indicated is to first thoroughly clean the parts and then fit or burnish into the opening a piece of pure gold plate or foil of suitable dimensions, which may be held in place by holding the work in a favorable position to sustain it, or attaching it by the fusion of the flux. A piece of solder somewhat larger than the perforation should then be placed in position, covering same, and likewise held in place, and then heat uniformly applied until the solder becomes firmly attached without complete fusion. In small perforations solder alone will accomplish this end, without the use of a support of pure gold or other metal.

Autogenous Soldering. Autogenous soldering is the process of uniting surfaces by immediate inter-fusion, without the use of a lower grade alloy and while it has no decided advantages, excepting that a joint so made is not increased in stiffness or thickness, and the appearance of a seam of solder is avoided, it is quite easily accomplished in uniting bands and attaching solid cusps to them, in the execution of which the surfaces must be *perfectly* approximated, retained closely in contact, properly fluxed, and held in the flame until union is accomplished by superficial fusion. By a little practice one may become quite skilful, and joints so made usually possess every element of strength.

Soft Soldering. While soft soldering is not to be generally commended, it is sometimes indicated in emergency cases, where some strength in the union of the parts is required, as in temporary crowns, etc. For such purposes a solder composed of equal parts of tin and lead, or any of the fusible alloys, may be used, either with a soldering iron or by placing them upon an asbestos pad and directing the flame of the burner upon them until the solder fuses. A convenient flux for this work is made by gradually adding pure zinc to hydrochloric acid until the chemical action subsides or the acid refuses to take up more, thus making a solution of zinc chloride, when it may be filtered and is ready for use.

Investing and Investment Materials.

CHAPTER IV.

Object of Investing. Requirements of Material. Materials Used. Physical Properties. Models. Requirements of an Investment. Preparing Case for Investment. Hard Wax. Adhesive Wax. Investing. Small Cases. Extensive Cases. Precautions. Removing Wax. Preparation of Investment. Drying and Heating. Prepared Compounds.

One of the most important features to be observed in connection with the process of soldering is the proper investment of the case, the object of which is to sustain the relation of the parts and preserve a uniformity of temperature during and succeeding the application of heat.

Object of Investing.

By investing the parts the uneven or too rapid heating or cooling of porcelain facings and the consequent attending dangers are obviated, and any possible change in the individual relation of the parts while being united or assembled is entirely overcome.

Requirements of Material.

A suitable compound for such purposes should possess the essential properties of crystallization, infusibility, free conductivity and strength, and should neither shrink nor expand appreciably during the heating process.

Materials Used.

Many substances may be used in combination with plaster of paris, which is necessarily the basis because of imparting the property of crystallization, and which must be incorporated to the extent of at least 50 per cent.

The remaining proportion may be then composed of such materials as will, by virtue of their characteristics and physical properties, meet such requirements. The following are serviceable:

Powdered Silex,	Pulverized Pipe Clay,
Fine Asbestos,	Powdered Fire Brick,
Beach Sand,	Magnesium Oxide,
Marble Dust,	Pumice Stone.

A combination of any of these ingredients in varying proportions with the proper quantity of plaster will usually possess the necessary qualities, excepting pumice stone, which, because of its low fusibility and inherent tendency to expand should never be used, and asbestos in large proportions, which, while serving to hold the mass together, when mixed, is objectionable because of its extreme low conductivity.

Physical Properties. The property of free conductivity is important because this materially lessens the time consumed in heating the case, by absorbing and distributing the heat more rapidly and evenly, and by thus retaining it the better the soldering is facilitated, and the liability of checking porcelain facings diminished.

A tendency on the part of any compound to expand and crack open when subjected to the influence of heat usually indicates that the texture is too fine to admit of the rapid evaporation of the moisture, and as possible displacement of the parts and checking of facings is thereby promoted, the use of such material is objectionable and unsafe.

By the addition of a coarser ingredient to the compound, however, this fault may be overcome, and a small quantity of fine shredded asbestos will also frequently eliminate the objection in a measure, without greatly reducing the property of conducting heat.

Models. While, generally speaking, all models should be made of plaster alone, because of thus possessing greater strength, smoother surfaces and more accurate and definite outlines, while offering no impediment to successful soldering when properly prepared, there may be frequent indications for making them of investment material.

In such instances a material which will shrink or expand appreciably is decidedly objectionable, and the characteristics of that used for such purposes must be of known quantity, for the reason that a degree of inaccuracy in the relation of the parts and their proper adaptation may result.

Where such a model seems indicated and desirable, and especially for the purpose of the final assemblage of the parts in extensive cases, a smooth, well-defined surface may be secured by first pouring a small quantity of thin, well-mixed plaster into the impression, then inverting the cup until all surplus runs out, leaving only a thin surface coating, when by being immediately filled with the investment material, a model is obtained possessing a veneer of plaster.

Requirements of an Investment.

As the object of investing is to hold the parts in their proper relation and afford protection to the facings, it is but necessary that the investment should be *only large enough to accomplish* this end.

Any surplus in excess of merely meeting such a requirement increases the heat necessary and adds to the labor involved in the process of soldering, without any possible advantage.

Preparing Case for Investment.

In assembling the individual parts on the model, some means should be observed which will temporarily sustain their accurate relation until they are safely transferred to the investment. In this particular it is necessary that they should be so securely united as to prevent any possible displacement during the process of removing from the model, and the subsequent imbedding into the investment material, with a substance sufficiently tough and strong to withstand such procedure.

This is usually accomplished by using a hard or adhesive wax as a medium of cementation, which in large cases may be further supplemented by covering the facings and crowns from the buccal or labial surfaces with a thin layer of plaster or investment compound previous to removing from the articulator. (Fig. 24.)

In interrupted bridges or where some adaptation of bars or rests to a proper relation with the natural teeth is indicated, it may often be done

to better advantage after the case is invested than when on the model. In such instances by extending or continuing the wax over these teeth so as to secure an impression of them before detaching and investing, their accurate reproduction may be secured in the investment.

Hard Wax. For the purpose of thus securely cementing the parts a hard wax composed of from two to four parts of resin and one of wax is reliable and much used. The combination forms a stiff, brittle substance, which for convenience should be rolled out into sticks of suitable size and length. These may be kept indefinitely by coating the surfaces with whiting or plaster to keep them from adhering to each other. Parr's fluxed wax may also be used for the purpose.

Adhesive Wax. As the extreme brittleness of *hard* wax is sometimes objectionable, a less brittle and more adhesive compound may often be found preferable. The following formula gives an adhesive wax possessing excellent qualities: White bee's wax, 8 oz.; pulverized white resin, 1½ oz.; gum dammar, 1½ oz. Melt in order named.

Investing. When the various parts are securely and firmly united, the wax should then be carried over a considerable surface of the abutment crowns and caps, including every portion of the work not to be subsequently covered by investment material. This procedure serves to keep such surfaces clean and free of dirt, and leaves them fully exposed in the investment, by guiding the flowing of same over only those parts which should be protected.

Small Cases. In all cases, ranging from a single crown up to four or five teeth, the abutment crowns and caps should be detached from the model, previous to cementing the parts, in such manner as to preserve their definite outline and relation. Upon being again replaced in their proper position all of the individual parts may be assembled and cemented together, when the whole can be easily removed and invested. This eliminates the destruction and investing of the model and preserves it for future use in case of desire or necessity.

Extensive Cases. In larger cases, however, it is not usually good policy to follow this procedure, because of the increased liability of an inaccurate replacement of the abutment caps and crowns, especially if there be more than two. In such instances it is always safest and best after assembling and cementing the parts firmly to first remove the model from the articulator, and then trim

away all surplus plaster until only enough remains to sustain the relation. (Fig. 25.) This, then, precludes the possibility of any disarrangement or displacement of the parts, and the remaining plaster is of no significance if entirely submerged and completely covered with the investment material.

Precautions. The investment compound should be mixed of a moderately thin and plastic consistency, so that when the proper quantity is poured upon a piece of paper it will offer no resistance in pressing the case down into place, until it is properly submerged and sufficiently covered. If too stiff there would be danger of a change in the relation of the parts.

To make sure of a close adaptation of the material to the facings and other parts, and to hold them securely when invested, all surplus wax and dirt should be carefully removed and the case dipped in water just previous to bringing it in contact with the investment material.

Fig.25.

The *interior* of all crowns and caps unless previously *well filled* with plaster should then be first thoroughly packed with the investment material by using a small piece of wood or fine-pointed spatula; because if not perfectly filled the presence of air spaces, into which the heat becomes concentrated during the process of soldering, will materially increase the liability of burning or fusing the parts, an accident which for this reason not infrequently occurs.

Removing Wax. After the investment has become thoroughly hardened and the surplus trimmed away, the wax should be slightly warmed by passing over the flame and removed as well as possible with a small knife-blade or other pointed instrument, being careful not to loosen or dislodge the parts in so doing.

Hot water may be then poured upon it, but the case should never be *boiled,* for the reason that such procedure disintegrates the compound, interferes with its perfect crystallization, and requires more time in drying out and heating up than would otherwise be necessary.

Chloroform, being a solvent of wax, is also used to remove remaining particles but this is entirely unnecessary, because the wax will be absorbed by the investment and ultimately burned out entirely during the heating process.

Preparation of Investment.

As soon as the wax has been sufficiently removed, the investment should be trimmed down until no larger than is absolutely required, thus leaving all surfaces upon which the solder is to become attached *freely exposed*, so as to offer no impediment to the heating of the case. No danger will accrue from this free exposure of the

Fig. 26.

parts if the porcelain facings are covered and the interior of crowns and caps well filled, and the labor involved in the process of soldering will be materially lessened.

The investment for a single crown should be cut away from the approximal sides on a line with the backing and cap. (Fig. 26.) Where this is not observed and the investment remains banked up on these sides,

Fig. 27.

the crown is imbedded into a depression, and the soldering is made much more difficult because the flame and heat from the blow-pipe is thus deflected from the parts.

This applies as well to more extensive work, and should always be closely observed. The proper exposure of the metal parts and the necessary trimming away of the investment for larger cases is illustrated in Fig. 27.

Drying and Heating.

When the preparation has been completed and all particles of débris removed, the parts should then be fluxed, and the case placed upon the burner until it gradually becomes sufficiently heated to proceed with the soldering.

Many devices are provided for holding the case in the flame, but the simplest, most useful and economical method is to put it upon a piece of the ordinary metal lathing used in plastering, which is made of iron and is more or less durable, and then place this upon the spider over the flame. (Fig. 28.)

Prepared Compounds. Several preparations possessing the required qualities to a greater or less extent can be easily procured, among which may be included Dr. R. C. Brophy's "Imperial Investment Material," the investment compound made by the Consolidated Dental Manufacturing Company; "Sump," prepared by the S. S. White Dental Manufacturing Company, and "Teague's Compound," all of which are of special merit and can be highly recommended.

Requirements and Technique of Crown Construction.

Indications and Requirements.

CHAPTER V.

Indications: Extensive Caries. Accidental Causes. Discoloration. Malformation. Malposition. Requirements: Physiological Relations, Anatomical Relations. Stress. Articulation and Occlusion. Approximal Contact. Mechanical Relations. Method of Attachment. Dowels. Telescoping. Fit. Strength. Esthetic Relations.

Before one is properly prepared to consider the manipulative procedure incident to the detail of construction of artificial crowns, a clear conception and a thorough understanding of the indications for, and requirements of such substitutes for the natural crowns of teeth as are generally applicable today are essentially necessary.

It does not matter particularly in what line of art or mechanics one confines his efforts, to meet with success in the direction chosen requires, first of all, the necessity of formulating in the mind, or picturing in the mental eye, the result of the contemplated effort in the finished state, before even commencing the detail of its construction.

To thus conceive the possible result before the execution, in a work where art and mechanics are so closely related to nature, greatly enhances the possibilities by cultivating the possession of those lucid and perceptive ideas which are so essential to success if success is dependent upon the attainment of special skill, as it should be.

And yet while dentistry offers no greater opportunities for the acquirement and display of the highest artistic talent than in the field of crown-work, such prerequisites alone will not always insure success, but must be supplemented by a degree of accuracy, facility and delicacy in instrumentation which will at once inspire the confidence of the patient.

Thus will he be the better qualified to obtain results more accurately restoring the normal functions and more closely approaching a reproduction of nature; and to perform them for the most nervous, sensitive patients with more gratifying success to all concerned.

In this field, as in many others, those methods which are *quickest* and *best* are not necessarily synonymous, and so it often becomes a matter of judgment and discrimination as to the employment of the particular method most applicable to the case at hand, in which the operator must be governed only by the most scrupulous and conscientious efforts.

While there may frequently be several methods of procedure that, at the first conclusion, seem apparently applicable, there is usually one in particular which upon closer observation will best meet all of the requirements.

Indications.

The employment of artificial crowns is indicated in extensive loss of tooth structure from the ravages of caries, or accidental causes, and not infrequently because of discoloration, malformation and malposition, as a means of substitution for the correction and restoration of impaired function, and relief from disfigurement. There should always be enough tooth structure remaining, however, to insure sufficient anchorage.

Extensive Caries. By far the most general indication is in those instances where the natural tooth structure has suffered such irreparable loss from the process of caries, as to make restoration by filling, with any assurance of permanency in the operation, either inadvisable or impossible.

In those cases, however, where it seems a matter of conjecture as to the advisability of filling or crowning, unless for esthetic reasons, the preference should be given to filling, if such procedure may seem to offer any certainty of a reasonable degree of success and permanency.

In frequent instances the remaining walls of badly broken down teeth may be protected and usefulness restored for many years by the insertion of a post into the canal, and the building of a filling around it, and such a course is often indicated for the reason that the crowning operation may then be deferred and become a subsequent and possibly remote necessity, which would perhaps add to the aggregate longevity of the root.

Moreover, the presence of a well-adapted filling is no doubt more conducive to the preservation of the normal condition of the surrounding tissues, than the most skillfully adapted crown.

Accidental Causes. The loss of a portion or all of the natural tooth crown in the anterior region, as the result of a fall or blow, or from overstrained masticatory action upon hard substances in the posterior region, is by no means uncommon, and usually calls for immediate relief in their reproduction and restoration.

Discoloration. The presence of a badly discolored tooth in the anterior part of the mouth, which persistently refuses to succumb to repeated efforts at bleaching,

Fig. 29.

may often indicate an artificial substitute as the only means of effectually and permanently remedying its conspicuous and objectionable appearance.

Fig. 30.

Malformation. In such conditions of faulty enamel formation as the so-called "peg" laterals (Fig. 29) and the pitted enamel structure, as is frequently found to exist in the first permanent molars and the anterior teeth (Fig. 30), the

Fig. 31.

application of an artificial crown may often be indicated as the best means of restoring usefulness and affording relief from disfigurement.

Malposition. There are frequent instances of simple irregularity of the anterior teeth, where the age of the patient, together with the presence of caries or other conditions may not seem to warrant their correction by the process of

regulating. Often the desired effect may be obtained by sacrificing the natural crowns and substituting artificial ones as the most simple and artistic means of correcting the deformity. (Fig. 31.)

Requirements.

The success of crown-work in the various phases of its application, and the degree of permanence in the operation, combined with the esthetic results obtained, depends upon a close observation of the requirements from a physiological, anatomical, mechanical and esthetic standpoint.

Physiological Relations.

When it has been determined that a crown is indicated or seems to be the most advisable procedure, it is first necessary to ascertain the condition of vitality of the immediate and surrounding tissues. If pathological conditions exist, every effort should be made to locate and remove the cause, and the usual remedial or medicinal agencies should be applied until the tooth or root assumes as healthy and normal a condition as possible before proceeding further with the operation.

This particularly includes the *thorough disinfection* of the remaining tooth structure, and the removal of all that may prove irritating to the peridental membrane. The precaution is necessary because the presence of an artificial crown should not afford any more reason or opportunity for the deleterious action of disease-producing agencies than when the tooth was in a normal healthy condition; indeed, it should even further fortify it against attack.

Anatomical Relations.

In regard to anatomical relations we are governed by the position of the root and the artificial crown supported by it in their relation to the adjacent and antagonizing teeth, which includes the consideration of stress, occlusion and approximal contact.

Stress.

The roots of teeth carrying crowns are subjected to the influence of stress in different directions, according to their location in the arch, which fact demands that the construction and application of artificial crowns should be made with a view of affording a degree of resistance sufficient to secure the greatest integrity of both.

As the line of the greatest natural resistance is in the vertical direction, every provision should be made tending to prevent undue and unnatural stress, which might ultimately cause displacement, trouble, or possible loss of the root.

In the anterior teeth the general tendency of the stress imposed is to force them outward and forward, which may and should always be re-

lieved as much as possible by the proper preparation of the root, the restoration of approximal contact, and the method employed for the attachment of the crown.

In the bicuspids the stress is received in both vertical and lateral directions, which demands a firm seating to accommodate the former and a strong method of anchorage to overcome the latter.

The molars are least susceptible to displacement for the reason that lateral stress is limited in proportion to the degree of the normal accuracy of occlusion; and as the greatest stress is in the direct or vertical line, the essential requirement is a good firm seating, supplemented by accurate occlusion.

Articulation and Occlusion.

The degree of usefulness and longevity of the artificial substitute depends greatly upon such formation of the articulating surfaces, and in the posterior region the arrangement of cusps and sulci in their relation to the antagonizing teeth, as will restore their normal functions. The arrangement should provide for correct position not only when the teeth are in direct occlusion, but also in their articulation or the act of bringing them into occlusion.

The evils of faulty and imperfect occlusion are often apparent, and result frequently in marked manifestations of virulent peridental and neurotic troubles.

Approximal Contact.

The restoration of approximal contact is of the greatest importance, and is made so because of the necessity for protecting the tissues in the interproximal spaces from the serious results of irritation.

These tissues promptly rebel against the slightest irritating influences to such extent as to demand the most stringent efforts toward their protection and preservation.

Mechanical Relations.

Due thought should be bestowed upon the method of attachment, fit and strength of artificial crowns, all of which are so necessary and add so materially to the durability and degree of permanency in the work from a mechanical standpoint.

Method of Attachment.

Two general methods of attachment are employed, each or either of which may be indicated by the style of crown required, and the amount of tooth structure to which the attachment may be made.

Dowels.

In roots which are even with or approximating the gingival line, attachment must necessarily be made by inserting a dowel in the direction of their

longitudinal axis to a depth, where possible, equal to the length of the crown from cervix to incisal or occlusal edge.

Such a mechanical fixation, whether the dowel be previously attached to crown or root, practically precludes the loosening of the parts from strain, at the line of junction, overcoming leverage at that point by distributing it throughout the length of root, and forms a most secure means of anchorage.

Telescoping. Where enough of the root is freely exposed to afford a firm grasp of the crown, the attachment may be securely made by telescoping, in which the strength at the line of junction naturally increases in proportion to the surface of tooth structure covered by the crown.

Adaptation—Fit. The relation existing between the crown and root is of the greatest possible importance, because the ratio of subsequent failure or trouble arising from the progress of caries, or from gingival or peridental irritation, is decreased in proportion to the degree of accuracy in the adaptation.

The crown should be seated firmly upon the root, and if no band is used the adaptation should be close enough to make a joint as flush and impervious as possible, so that the end of the root may be thus protected.

When a band is used, it should pass under or within the free margin of the gum a uniform distance on all surfaces of the tooth and *only* far enough to cover and protect the seam of union, which should be in such close proximity to the root as to preserve its continuity and make a smooth line of junction between the two.

Strength. The durability of this work depends to a very large extent upon its inherent strength, which it should always possess to a degree sufficient to permanently withstand the stress of mastication, even though it be gained at the sacrifice of more or less artistic results when occasion requires. Any tendency toward undue economy usually proves disastrous.

Esthetic Relations. These considerations embrace the field which gives the greatest possible scope to the individuality and artistic temperament of the operator, and while it is true that art can never entirely and completely take the place of nature, the aphorism is less applicable to this special line of work, perhaps, than to any other department of dentistry or of art.

To secure the highest artistic results, the artificial crown should preserve the gingival outline, and the symmetrical alignment of the teeth;

should be proportionate in length with the adjacent teeth, and if of porcelain should closely match them in color, and should correspond favorably in general form and characteristics with its fellow member of the opposite side of the arch.

As a rule, where porcelain is used no metal should be exposed to view from any surface, unless purposely done to more closely match the adjacent teeth or the corresponding tooth.

In instances where the remaining natural teeth are freely filled with gold, the artificial substitute should often carry filling which will enable it to more closely resemble and harmonize with them, thus making detection more improbable, which legitimate deception is a true evidence of artistic endeavor.

The Preparation of Roots.

CHAPTER. VI.

Preliminary Requirements: Therapeutics. Feasibility of Devitalization: Physiological Considerations; Mechanical Considerations. Treatment of Hypertrophy. Free Exposure of the Root. Classification. Preparation for Shell or Telescope Crown: Requirements; Restoration of Continuity; Diminution of Coronal Proportions; Paralleling Converging or Diverging Teeth; Operative Procedure. Preparation for Shell or Telescope Crown with Porcelain Facing: Requirements. Preparation for Band and Dowel Crown; Requirements; Operative Procedure; Excising Incisors and Cuspids; Excising Bicuspids and Molars; Removal of Enamel: Use of Enamel Cleavers; Peripheral Trimming; Shaping Basal Surface. Preparation for Dowel Crown without Band; Requirements; Operative Procedure; Inseparable Dowels; Separable Dowels; Protection of Unsupported Walls. Preparation of Canals; Requirements; Operative Procedure. Treatment of Perforated Roots. Treatment of Fractured Roots; Posterior Teeth; Anterior Teeth, Prognosis.

Paramount among the obstacles in the pathway of success, permanency and comfort in crown and bridgework is the perfunctory, unskilful and profoundly indifferent methods so often employed in the procedure incident to the treatment and preparation of roots

In the entire subject there is probably no one distinctive feature of such intrinsic importance as the practical, scientific and skilful preparation of the remaining crowns and roots of teeth, for the reception of artificial crowns.

While the proper and necessary operative procedure may be arduous, and replete with attending difficulties, the physiological and mechanical requirements are equally exacting, and demand the same degree of care, precision and accuracy that would be essential to the preparation of the foundation for any superstructure designed as a permanent evidence of skill and usefulness.

More particularly is this true in our efforts, because the field of labor is confined to living sensitive tissues which are so responsive to unnatural conditions that any apparent negligence must sooner or later manifest itself, not alone in evidences of failure, but also in the serious discomfitures accompanying the various stages of irritation.

These usually present in the nature of gingival inflammation, and peridental and alveolar absorption, to which conditions may be attributed a very large percentage of the troubles arising, and the absolute loss of many teeth. The common and exciting cause of such prevalent and sometimes discouraging results can invariably be traced to faulty and imperfect *adaptation* of the artificial crown, which in turn reverts, primarily, to inadequate and unskilful *preparation* of the root supporting it.

As clinical experience proves most conclusively that comfort and permanency depend upon a conservation or reproduction of the natural conditions, such liabilities decrease of course in proportion to the degree of accuracy observed in the operative procedure.

And as a degree of accuracy may only be obtained by an appreciation of the significance and importance of the requirements, a broad comprehension of the underlying mechanical principles, and a thorough, conscientious execution of the details is necessary.

To facilitate this the consideration of the subject must necessarily be in accordance with a more or less scientific and systematic arrangement, in the order of the practical application of the principles and technique involved.

Preliminary Requirements.

When it has been determined that an artificial crown is indicated the first essential features to be observed should always include a consideration of those requirements constituting the preliminary operative procedure incident to placing the roots in the most favorable condition possible for the subsequent permanent attachment of the crown.

Therapeutics. The very *first* detail is obviously that of the therapeutic treatment necessary in securing an *aseptic* condition of the root, including pulp canals and surrounding tissues.

This should invariably precede the removal or destruction of any of the remaining walls, because of the facility which their retention affords for the application of the rubber dam, which is essentially desirable and advantageous in rendering the field immune from secretions while medicinal applications are being made.

After the removal of all disintegrated structure, the usual remedial agencies indicated by the requirements and the existing conditions should be consecutively applied, until *thorough asepsis* of sufficient potency to preclude any possibility of subsequent disease or disintegration is obtained.

When this has been successfully accomplished, the pulp canals should be thoroughly filled throughout their entire length, irrespective

of the style of crown indicated, and the root filling then temporarily covered and protected with cement to exclude the deteriorating influences of moisture during its hardening and crystallization.

Feasibility of Devitalization.

The problem of the feasibility of sacrificing the vitality of pulps in teeth which are to be subsequently crowned is one of great importance, and is a portion of the operative procedure incident to the preparation of such teeth, which requires the most conscientious and conservative consideration.

For many years no special thought was given to this feature, and such teeth as seemed to indicate restoration by crowning were treated much in the same manner as though fillings were to be inserted.

The frequency of subsequent troublesome manifestations, however, including the ultimate death of pulps with the attending consequences of such pathological conditions as virulent peridental inflammations and alveolar abscesses, have since caused the subject to be more carefully considered, until it is now most generally conceded to be a safer precaution, in a great majority of cases, to destroy such pulps as a prophylactic procedure as well as to facilitate the necessary mechanical preparation, when the crown is to entirely cover the end of the root.

Physiological Considerations.

It is now a more or less generally acknowledged belief of the most eminent authorities that the pulp is purely a formative organ, and that its physiological function terminates with complete development of the tooth; that it is not necessary to its vitality, stability and longevity after maturity, providing that the pulp cavity is perfectly filled; thus there seems to be no good reason for its preservation, taking into account the modern aseptic means of removing it and treating and filling the canals.

Especially is this true where a crown is indicated, because the abnormal encasing of the tooth so as to practically isolate it must at least diminish the external influences of secretions and temperature upon the nerve and blood supply of the pulp; and because usually such teeth have already been subjected to the irritating and devastating influences of caries, each of which seems but to invite and pave the way for ultimate destructive processes.

Other deleterious influences may come from the irritating action of the cements used in mounting, or from the effects of the *shock,* or overstimulation induced by the necessary mechanical preparation, either of which may often prove important factors in rendering such teeth susceptible to a "slow but often complete and unnoticed destruction."

All things considered, the prophylactic measure seems the conservative one, and as modern scientific root treatment offers no palpable excuse for subsequent pathological conditions, it seems that the orthodox dogma of *preservation* is inapplicable to a great majority of cases, where experience and judgment teach us the demand for a perhaps more "radical" but manifestly *safer* procedure.

The contraindication for such treatment would be in the mouths of patients under sixteen years of age, where in all probability complete development of the tooth had not yet been attained. In such instances, however, it would be as unwise to pass the crown entirely beneath the gum as it would be to destroy the vitality of the pulp, unless both were necessary. And after fifty years of age the necessity for such treatment is often greatly diminished because of the physiological phenomena of the gradual atrophy of the pulp, and the formation of secondary dentine, which so lessens the sensitiveness of the structure as to admit freely of the necessary preparation, while reducing the probability of the ultimate occurrence of pathological conditions to a minimum.

Occasional exceptions may also be warranted in those cases of abnormal development, faulty enamel formation, extensive abrasion as a result of attrition, and where the absence of adjacent and occluding teeth makes necessary but little, if any, preparation, but such indications can only be governed by experience and judgment.

Mechanical Considerations.

Because these considerations apply more particularly to the posterior teeth, where the shell or telescope crown is indicated, and where the removal of a considerable portion of the remaining tooth structure becomes an *absolute requirement,* the destruction of the pulp is usually imperative as a means of *making possible* and *facilitating* the necessary preparation in the diminution of the coronal proportions of the natural crown.

When the vitality is preserved, this procedure, always exacting, is ordinarily so *difficult* that it must be either perfunctorily and negligently performed, or else the patient must be made to tolerate an exceedingly and often excruciatingly painful operation.

Frequent evidences of flagrant indifference and negligence are so manifest as to prove conclusively that in a large majority of cases the vigorous efforts necessary to secure the best and most successful results may *only* be obtained under the most *favorable* conditions.

Treatment of Hypertrophy.

In instances where an exuberant growth or hypertrophy of pulp or gum tissue is present, or may have almost entirely covered the end of the

root, some difficulty may be experienced in applying the dam and pursuing the necessary course of treatment.

Both may be greatly facilitated, however, by the immediate excision and removal of such tissue at the first sitting, and if the continuity of the root be destroyed by disintegration, or if its length will not admit of the application of the clamp and rubber dam, a temporary restoration can be easily effected by adjusting a band of German silver closely encircling the circumference of the root, as soon as the suppression of the hemorrhage, by the use of styptics, will permit.

Such a band, if properly and carefully fitted to the neck of the root, and trimmed so as to have no sharp or irregular edges, and not to interfere with the occlusion, will at once admit of the application of the dam by adjusting the clamp over it, and may remain in place and be worn with comfort until the necessary treatment and final filling of the canals has been accomplished.

If filled flush to the edge with temporary stopping at the end of each treatment, it further serves to hermetically seal the dressing within the root, and to compress the tissues so as to afford a free exposure of the periphery.

Free Exposure of the Root.

During the process of treatment in all badly broken down roots some means should *always* be employed to compress the tissues in such manner as to freely expose the end, which greatly facilitates the fitting of the band, or the adjustment of the crown, and materially lessens the usual discomfiture attending the operation.

When the use of a temporary band is not indicated, or seems unnecessary, the same advantages may be gained by packing temporary stopping into and over the end of the root, and *under* the free margin of the gum.

If the root is too shallow to anchor it securely, it may be so retained by packing tightly against the adjacent teeth, or held firmly by ligatures attached to them, or by inserting a small sharp tack through it and into the tooth structure.

In instances where the accumulation of gases demand some vent, a perforation may be made through the stopping at a convenient point.

Care should also be exercised to prevent *undue pressure,* which, if existing for an indefinite time, might possibly cause injury to peridental membrane or surrounding tissues, as a result of protracted lack of circulation.

Classification.

The principles involved in the necessary preparation of roots are governed, of course, by the particular style of crown indicated, and, while crown work is divided into two general classes, according to the method of attachment employed, a variation in the essential details of their individual construction requires that each class be subdivided, and that the subject be considered in four general classes.

In order to meet the requirements occasioned by this variation, each class will be considered separately, and are as follows:

Preparation for shell or telescope crown.

Preparation for shell or telescope crown with porcelain facing.

Preparation for band and dowel crown.

Preparation for dowel crown without band.

Preparation for Shell or Telescope Crown.

Requirements. The detail of procedure indicated by the requirements for a shell or telescope crown, because of being generally confined to the posterior teeth, is usually the most difficult, and should be closely observed.

Restoration of Continuity. In those instances where the ravages of extensive decay have caused the destruction of the remaining walls of the natural crown, so as to carry the cervical border at some point within or beyond the free margin of the gum, some means of permanent restoration of the continuity of the root is usually advisable.

This prevents the possible fracturing of unsupported walls during their preparation; adds materially to the integrity of the root; greatly facilitates the fitting of the band, and overcomes the probability of subsequent disintegration arising from an imperfect adaptation of the band to the margins of deep cervical pockets.

Such restoration can usually be best accomplished with *amalgam,* the use of which affords a better opportunity for securing a close adaptation between it and the margins of the root, with the assurances of a greater degree of permanency.

Where the edge of the band, however, *can* be fitted closely to the root at all points around its entire circumference, with a reasonable degree of certainty, and where the walls are weak, the use of cement for this purpose is preferable, because of the additional support rendered by its adhesive qualities, and because any further destruction of the tooth

structure for the purpose of securing retention is unnecessary; but when the extreme depth of the marginal edge (Fig. 32) makes a close adaptation of the band either *impossible* or *doubtful,* amalgam should be used.

In using amalgam adequate retention must be secured in the pulp chamber, or root canals if necessary. A thin circular matrix of German silver, g. 34-36, should then be adapted, and so shaped as to make the restoration of suitable form to save further preparation. After adjusting this, its inner surface should be coated with vaseline, oil, or any lubricat-

Fig. 32.

ing substance, to prevent adherence of the amalgam, and insure its easy removal after crystallization. To admit of and facilitate this the amalgam should never extend as high as the edge of the band, and a subsequent sitting is usually necessary. (Fig. 33.)

In roots where the entire crown has been destroyed, it is usually necessary to rebuild and restore a portion of it, in order to better and more securely sustain the artificial crown, by obtaining greater integrity between it and the root at the line of junction. This may be easily ac-

Fig. 33.

complished by adjusting the matrix, and firmly inserting a screw-post into the most accessible canal, additionally fortified with cement (Fig. 34), and then building up with amalgam to the desired length and shape.

Diminution of Coronal Proportions.

The diminution of the natural crown, or its remaining walls, in a manner favorable to the requirements, is frequently a very difficult procedure because of the usual inequality, in teeth of normal proportions, between the diameters of the crown and the cervix.

This requires and necessitates the removal of considerable tooth structure in order that the circumference may be reduced at every point occlusally, and at the uniform expense of each surface, *at least equal* to the exact dimensions at the cervix.

While it is, of course, desirable to leave as much as possible of the remaining coronal portions, it will be observed from the illustrations (Fig. 35) that approximately about one-sixteenth of the structure from the axial walls, and the occlusal one-fourth must be removed.

Fig. 34.

Such a requirement is not a hypothesis, but a physical and mechanical problem which must necessarily be closely observed, in order that it may be made possible for the band to approximate a close adaptation to the normally constricted neck; and to admit of a reproduction of the occlusal service in the artificial crown possessing sufficient thickness to withstand the influences of constant attrition

To further increase the opportunities for securing a closer continuity between crown and root, the remaining walls should not merely be parallel,

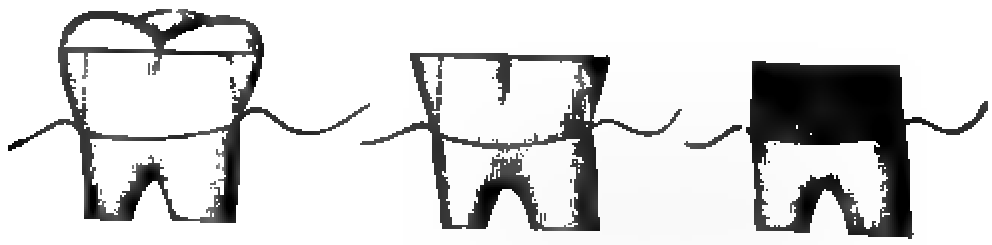

Fig. 35.

but should be slightly *inverted,* so that the band may *fit more closely as it is pressed rootwise*, and thus prevent its edge from being forced *into* the gum tissue, instead of *under* or *within* the free margin.

This requirement is indisputably essential when the crown is intended to approach or pass beneath the gum, if comfort and permanency are to

be obtained from the operation, and is one of the strongest arguments in favor of the devitalization of the pulp.

Paralleling, Converging or Diverging Teeth.

Owing to the general tendency of teeth to gravitate or tip toward the unoccupied area in interrupted arches (Fig. 36), in their preparation for bridgework it is essential to observe that the surfaces of each individual root presenting toward each other, are made absolutely perpendicular, as illustrated in Fig. 37.

Such a condition will frequently be found, and no matter how per-

Fig. 36.

Fig. 37.

fectly each individual root should be prepared, the presentation of perpendicular lines is necessary to admit of the adjustment of the bridge after completion.

Operative Procedure.

As this portion of the operation is particularly trying to the patient, as well as the operator, a good assortment of stones, disks and burs, kept sharp, even-edged, and mounted true, is essential, and all unnecessary grinding should invariably be avoided.

When any of the walls of the tooth remain or approximate their full length, the first detail should be to undermine the enamel to the desired point by cutting away the dentine with a sharp bur. Such walls may then be easily broken down with the excising forceps, and much unnecessary grinding thus avoided. The surface of the occlusal end should

be ground smooth with a thick-edge stone. The buccal and lingual walls may be reduced with a *thin-edge* stone of suitable diameter, in which it is essentially necessary to keep the revolving stone moving upward and downward against the surface of the tooth, to prevent the formation of a shoulder or ridge at any point, and to assure a uniform reduction.

After these walls have been adequately reduced, the trimming of the approximal walls, usually the most difficult, is next in order. When they

Fig. 38.

remain high enough to afford considerable support to the enamel, grinding must still be resorted to, as the cleavers will be found practically useless in detaching and removing it unless it is more or less disintegrated.

For such purposes a thin-edge stone or diamond disk of suitable diameter may be used, by beginning from the occlusal end, at a point about one-sixteenth of an inch from the periphery, and cutting through on a slight angle until the interproximal space is reached.

Fig. 39.

A small cross-cut fissure bur inserted into the interproximal space at right angles to the teeth, and brought occlusally with considerable pressure against the root, may often serve as a valuable supplement to the stone, or sometimes answer the purpose itself, if sufficient care be exercised to prevent mutilating the adjacent teeth, which may often be protected with a band matrix.

When adjacent teeth are absent, the procedure is less difficult and may be accomplished with a blunt safe-edge stone, as illustrated in

Fig. 38, or a stone possessing the shape of an inverted cone. The latter is very often found most useful in reducing the surfaces of molars.

If the remaining walls are short, and the enamel is somewhat disintegrated, the *cleavers* may be found very useful.

When sufficient diminution of the structure has been secured, the sharp corners should be nicely *rounded* with burs and sandpaper disks, and the necessary preparation is then completed.

The degree of accuracy thus obtained will be denoted by the freedom and facility with which the measurement wire may be detached from the root after being twisted taut, and the buccal and occlusal aspects should present, as indicated in Fig. 39.

Fig. 40.

Preparations for Shell or Telescope Crown with Porcelain Facing.

Requirements. While the same general principles apply to the necessary preparation for a shell or telescope crown with porcelain facing, and the same detail of procedure is indicated, a variation is required.

This variation comprises grinding down the buccal wall sufficiently to accomodate the presence of the facing, as the area to be occupied by it must, of course, be gained at the expense of the remaining root, (Fig. 40.)

This should never be done, however, until after all other requirements, as before outlined, have been observed, and it may be done to even better advantage after the band has been fitted.

Preparation for Band and Dowel Crown.

Requirements. The requirements of root preparation for a band and dowel crown are similar in peripheral features to the requirements for a shell or telescope

crown, but differ in that *all* of the remaining natural crown must, of course, be sacrificed to more nearly approximate the gum line.

This is necessary because the line of junction between crown and root is made at this point in order to accomodate the artistic and esthetic presence of a porcelain facing.

Operative Procedure.

In the operative procedure incident to removing the remaining portions of the natural crown, as much of it as possible should be cut away and broken down to a certain point, in order to avoid all unnecessary grinding.

Fig. 41. Fig. 42.

Excising Incisors and Cuspids.

In the incisors and cuspids this may be quickly and easily accomplished by first undermining the remaining enamel with a bur, and then cutting grooves through it at a point which, when the crown is excised, will *leave a projecting end of the root* about one-sixteenth of an inch *beyond the gum line.* (Fig. 41.)

Care should be exercised in cutting the grooves entirely through the enamel, so as to relieve or reduce the shock, and prevent a fracture rootwise. The beaks of the excising forceps may then be placed in the grooves, and the crown easily and safely removed.

Excising Bicuspids and Molars.

In removing the remaining portion of the crown of bicuspids and molars, the grooves and excising forceps possess the same advantages.

In their use, however, any remaining *continuity between buccal and lingual walls* must also be first attacked with a bur to destroy their integrity. (Fig. 42.) This, in conjunction with grooves, will facilitate their excision without shock or danger of fracture.

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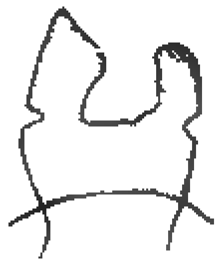

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Removal of Enamel.

The remaining ledge of enamel upon this projecting end of the root, which has been purposely retained, for the time, must then be removed in order to bring the greatest diameter beneath the gum, where the line of junction between band and root is to be made. This can be best accomplished by the use of enamel cleavers designed for the purpose.

Use of Enamel Cleavers.

The use of enamel cleavers of any design may or may not be of a desired degree of effectiveness; according to the manner in which they are manipulated, and the easy and expeditious removal of enamel depends entirely upon their proper manipulation.

The edge of the cutting blade of the instrument must be placed above the enamel and held at the *proper angle* in its relation to the surface of

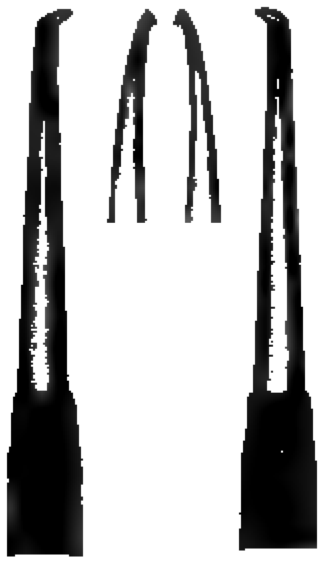


Fig. 43. Fig. 44.

the root: and a *fulcrum* must be established to facilitate the application and exertion of the necessary force to secure the destruction of what is usually a very dense attachment.

The adjacent teeth, when present, will serve as a means of establishing such a fulcrum; and in their absence the same may often be secured by placing a smooth piece of soft wood or rubber, of sufficient thickness, against the incisal or occlusal ends of remaining teeth, or the gums, against which the thumb may rest as a means of affording opportunity for securing purchase and leverage.

While various styles of instruments have been suggested for this purpose, those designed by Dr. C. S. Case (Fig. 43) will be found adimrably adapted to upper anterior roots; and those designed by Dr. A. G.

Johnson (Fig. 44) are especially useful for posterior and lower roots, though adapted for universal use. The manner of holding them in the hand and securing purchase upon adjacent teeth is illustrated in Fig. 45.

Peripheral Trimming.

After all enamel has been removed, the periphery of the root should be made smooth and to present a perpendicular line, as indicated before and after in Fig. 46. This can be easily accomplished with a small fissure bur; or, a set of trimmers suggested by Dr. J. H. Prothero (Fig. 47), or the "Root Reducer," manufactured by the S. S. White Co. (Fig. 48), both of which are designed for this purpose, and may be found useful.

Fig. 45.

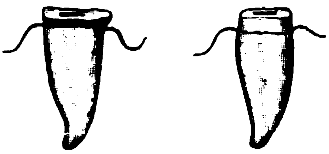


Fig. 46.

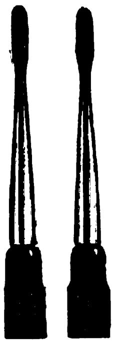


Fig. 47.

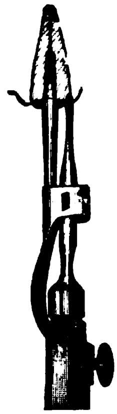


Fig. 48.

Shaping Basal Surface.

Before considering the final shaping of the end or basal surface of such roots, it may be well to emphasize that they have been *purposely* left projecting somewhat beyond the gum, as indicated, until the peripheral preparation is complete, because of *thus materially facilitating* the removal of enamel, and the subsequent taking of the measurement and fitting of the band, and for the reason that this freely exposed and projecting surplus end serves to retain the wire until an accurate measurement may be secured, and to *conform the band to the proper shape and guide it to place in fitting.*

The fitting of the band is thus made practically free from discomfiture to the patient, and easy for the operator, and after it has been fitted and trimmed to the desired width, the root should *then* be cut down to the proper form of base.

The shape given the basal surface of the root is of much importance, and particularly in the upper anterior teeth, where the requirements make it desirable to leave the lingual edge somewhat longer than the labial in

order to afford greater mechanical resistance to the stress naturally imposed, and to carry the labial edge a trifle beneath the gum, so that the band or cap may be *invisible*, and the neck of the porcelain facing placed in close proximity to the gum line.

Compliance with these mechanical and esthetic requirements results, of course, in beveling the end of the root, as indicated in Fig. 49 (which

Fig. 49. Fig. 50. Fig. 51.

is the common practice), or in shaping it on a slight and gradual *inclined plane*, as illustrated in Fig. 50. The latter is the best and preferable preparation, because of affording greater opportunities for the adaptation of the cap and facing without causing undue prominence at the neck (a common fault with artificial crowns), and with a minimum of grinding of the facing, and a maximum of strength in the crown.

Fig. 52. Fig. 53.

This can be best accomplished with a flat-edge carborundum or "vulcan" carborundum stone (Fig. 51), kept wet when using (the latter having the advantage of wearing true), until the gum line is reached, when the Ottolengui root-facers (Fig. 52) are most useful in cutting it beneath the gum on the labial or buccal edges, without lacerating the tissues. These should be of the "*safe-sided*" variety, and are made in

three sizes, to accommodate the size of root and the space between adjacent teeth, and should be used with extreme care, as they cut rapidly.

In the preparation of bicuspid and molar roots, where the stress is *direct,* it is usually desirable to leave the basal surface almost *flat,* as indicated in Fig. 53. This allows more opportunity for securing strength in the finished crown, and adds to the possibilities for its closer adaptation and for an observance of the more artistic and esthetic requirements.

In *no instance,* however, should this final preparation be made *until the band has been fitted.*

Preparation for Dowel Crown without Band.

In the preparation of roots for the dowel crown *without* band, the same procedure applies to the removal of the remaining natural crown, as indicated in the preparation for this style of crown with a band.

Requirements. After the remaining portions of the natural crown have been sacrificed, however, the essential features differ somewhat in the shape given to the basal surface, and in that the removal of enamel, or any peripheral preparation, is, of course, entirely unnecessary.

Operative Procedure.

As the permanency and success of such crowns depend, to a great extent, upon the degree of accuracy secured in the adaptation to the root, its end must be so shaped as to render the opportunities for a close adaptation most favorable.

Inseparable Dowels. In the preparation for that style of crown in which the dowel is an integral part (as the Logan crown), the form given to the basal surface should be exactly as indicated before, in Fig. 50, and the procedure is identical, *excepting the removal of enamel.*

This preparation becomes necessary because the presence of an immovable dowel makes the grinding of the crown to adaptation with the root somewhat difficult at best, but which is facilitated, of course, by having the root present as smooth a surface as possible. The labial surface may then be brought in contact with the gum margin, which is desirable for esthetic reasons, while the line of junction upon the lingual surface will be in accord with prophylactic measures in being rendered self-cleansing by exposure to the secretions and movements of the tongue.

Separable Dowels. The difficulty in adapting such crowns because of the interference of the dowel in grinding, constitutes the advantages possessed and afforded by those with separate dowels, such as the Davis crown.

Plate and Dowel. Where it is intended to construct the crown with plate and dowel as separate parts, to be subsequently attached with solder, and where the close adaptation of the plate may be secured by swaging or burnishing, the lingual portion should also be beveled almost to the gum line. (Fig. 54.)

By thus *saddling* the end of the root, greater mechanical resistance

Fig. 54.

is offered to the displacement of the crown, while the prophylactic requirements are secured in a better adaptation of the surface, and a closer approximation of the edge of the plate to the periphery of the root.

Protection of Unsupported Walls. In roots which present a concave base as the result of extensive decay, the walls should first be ground down until smooth, and as dense as the marginal outlines noted will admit, and then supported with a suitable material.

When the *continuity remains unbroken,* cement will best answer the purpose, but if some restoration seems necessary, the use of amalgam is usually indicated for the reasons mentioned.

As mechanical retention is frequently impossible, in these roots, some difficulty may be experienced in anchoring it where its use is indicated, but this may be accomplished by first thoroughly roughening or serrating the dentine with a wheel-bur, and then flowing over it a thin coating of cement and immediately packing the amalgam to place.

The cement thus aids materially in securely anchoring the amalgam, and a more permanent restoration is often afforded.

In very extensive decay these walls may sometimes be better sup-

ported by forming the base of the crown itself to closely fit them, so as to offer the necessary protection when mounted with cement.

Preparation of Canals.

The preparation of the canal for the reception of the dowel should always be the last procedure, and is of special significance since the dowel plays such an important part in the retention and stability of this style of crown.

Requirements. The necessary preparation consists in enlarging them sufficiently to receive a dowel *proportionate in size with the diameter and probable length of the root, and consistent with the requirements of the crown.* Any further enlargement and destruction of tooth structure is injudicious and unnecessary.

One dowel is sufficient to support any crown, *providing* that it may extend into the root a depth *equal* to the length of the crown (Fig. 55),

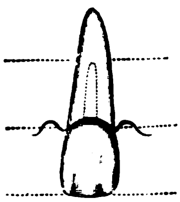


Fig. 55.

which is a mechanical requirement, and possess strength enough to withstand the stress.

In upper first bicuspid and in molar roots, however, if the probable length or constriction of the root precludes this, two may be used.

Operative Procedure. After first so determining the size of dowel indicated, or to be used, in the individual case, the canal should then be enlarged to receive it. A twist drill or sharp round bur approximating the same diameter as the dowel should then be selected, and the canal reamed out to adequate proportions.

In most instances it is desirable to extend the opening into the canal somewhat lingually, in order to permit the dowel to pass through the cap at a point which will carry its projecting and surplus end out of the way, so as not to interfere with the adjustment of the neck of the facing to proper relation.

Considerable care should be exercised, especially in bicuspid and

constricted roots, to avoid drilling through the sides of the root, as such perforations usually cause much trouble, and may often result in the loss of the root.

For this reason the round bur is considered the best and safest means of enlarging canals, because if of a proper size, and carefully guarded, as it approaches the periphery an immediate response will be manifested from its approaching proximity to the peridental membrane, in ample time to cause cessation of drilling and prevent perforation of root.

Treatment of Perforated Roots.

The presentation of perforations through the root, whether from accidental causes or as the result of caries, is usually a most aggravating state of affairs, and calls for much painstaking effort to again place such a root in condition to remain permanently comfortable.

A hermetical and non-irritating seal is required, for which purpose soft gold foil, tin foil, cement, white paraffin and gutta percha are generally used.

While all possess some good qualities, the use of chemically pure tin foil is most universally successful.

When these cases present, all septic and inflamed conditions of immediate and surrounding tissues should first be relieved by the proper medicinal applications. A small cone of chemically pure tin foil, about No. 4 thickness, should then be rolled, and inserted into canal, until one end is passed through the perforation. With a smooth, blunt, root canal plugger, the remaining portion of the cone should be gently packed against the walls over and surrounding the perforation, and then small pellets of slightly moistened cotton should be packed into the canal to burnish the tin to close adaptation.

Upon the removal of the cotton the tin may be protected and held in place by covering with chloro-percha and filling the root with cement.

When such treatment becomes *necessary before* filling the canals, their location may be preserved to admit of same by the insertion of a broach into each, the subsequent removal of which will leave them still accessible for further treatment and final filling, through the openings thus made.

The use of tin is preferable to other materials, because it is easily adapted, even in the presence of moisture, and is absolutely non-irritating, and offers a still greater advantage in the *hermetical* sealing afforded by the subsequent formation of the *oxide*, which chemical action is induced by contact with the moisture of the tissues.

Treatment of Fractured Roots.

The not infrequent presentation of fractured roots, and the difficulties usually encountered in their treatment, require a definite knowledge of the various means employed to restore and preserve their usefulness, and a delicacy and dexterity of manipulation in the procedure.

Posterior Teeth. In the posterior teeth these conditions usually result from overstrained or undue masticatory force upon such teeth as may have been weakened by the presence of extensive decay, or very large fillings, involving the approximal and occlusal surfaces, and causing a longitudinal fracture of the remaining crown and root.

Such fractures usually extend from mesial to distal surfaces, separating the buccal from the lingual cusps, and may often be successfully treated and permanent usefulness restored by crowning the root.

When such a course seems indicated, the first procedure should be the

Fig. 56.

thorough removal of all loose particles, by freely washing and flooding the tooth with tepid water, until a perfect and close approximation of the parts may be secured.

This approximation should then be securely retained, temporarily, until permanent fixation may be obtained by mechanical means. This may be accomplished by using well annealed German silver, or ordinary silver suture wire, from 23 to 26 g., which should be passed around the circumference of the tooth at the neck, and the ends then twisted tightly together.

The German silver wire is preferable because of admitting of greater strain without breaking, and if therapeutic treatment is necessary it may then proceed until the tooth and adjacent tissues are placed in favorable condition.

The mechanical procedure then necessary to firmly and permanently anchor the parts is governed by the extent of structure possessed by each independent portion.

If enough remains of each portion, they may be securely attached by cutting dovetail grooves in each, and then flowing a thin layer of cement over the entire interior surface, thus utilizing its adhesive properties, and then filling with amalgam. (Fig. 56.)

When the latter has become thoroughly craystallized, the wire may be removed, and the tooth carefully shaped for the reception of the crown. When insufficient structure in one of the parts precludes this procedure, the desired result may be accomplished by first wiring securely, and then adjusting the rubber dam and completely filling the tooth with thin cement

If the presence of moisture is prevented, the adhesive properties of the cement, in conjunction with the wire around the neck, will usually retain the parts until the tooth has been shaped, if *care* be exercised. In this particular, the stone should *always* revolve toward the fracture in order to prevent displacement.

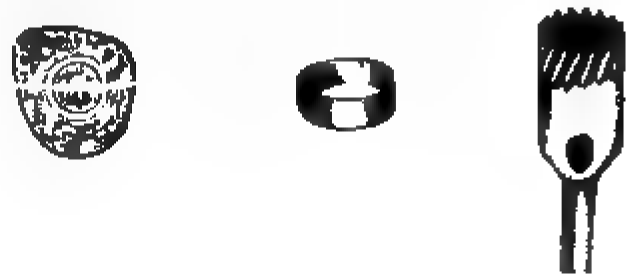


Fig. 57.

The wire may then be removed, and the crown fitted and mounted.

Anterior Teeth. Such fractures in the anterior teeth usually occur as the result of a blow or other accident; or from the stress of mastication upon an artificial crown offering no protection against such strain and perhaps mounted upon a root already weakened by too extensive or injudicious enlarging of the canal for the reception of the dowel.

When the fracture does not extend beyond the border of the alveolus to any appreciable extent, it is usually best to remove the loose portion, compress the tissues with gutta percha, and restore with amalgam. Or if the necessary retention is not possible, the base of the crown may be closely adapted to the root, and the restoration made with the crown.

When the fracture extends *beyond* the alveolus, however, it is usually desirable to secure fixation and retain the loosened portion, in order to prevent the resorption following its loss.

This may be accomplished by cementing and wiring until sufficient preparation can be made to admit of the adjustment of the crown.

If each portion possesses sufficient structure, additional strength may often be secured in their fixation by the use of an *intradental band.*

Where the length and thickness of the fractured part may seem to indicate such a procedure, the parts should first be tightly wired, as suggested, and then a circular groove trephined a consistent depth through the thickest part of each, into which a band may be subsequently fitted (Fig. 57), by the use of a very simple outfit suggested by Dr. B. J. Cigrand. When the band has been adjusted to the groove and ground smooth with the basal surface of the root, a firm secure fixation of the parts is insured, and the wire may then be removed and the crown adjusted.

Prognosis. While some little suppuration and trouble may be subsequently present as a result of reuniting fractured roots, it should give no unnecessary apprehension because if properly treated, and absolute immobility has been secured, it is usually of but temporary nature, and many roots so treated seem permanently restored to usefulness, indicating a very favorable prognosis.

The Shell or Telescope Crown.

CHAPTER VII.

Indications, Contraindications, Requirements: Telescoping Portion, Occlusal End, Methods: Sectional Method, Procedure; Measurement, Bands; Width, Length, Soldering, Fitting, Contouring, Occluding Bite, Impression. Articulators. Processes for Cusp Formation, Carved Cusp and Special Die Methods. Procedure; Swaged Cusps, Mould, Dies, Swaging, Adjusting Cusps, Soldering Cusp, Finishing. Solid Cast Cusps. Cusp Formation without Models. Use of Ash's Crown Swaging Device. Die and Die-Plate Methods; Individual Dies, Die-Plates; Application, Adjusting With Models. Adjusting Without Models. Hollingsworth System; Application. Millett's System, Application. Lowry System; Application. Baird System; Application. Seamless Method: Advantages. Disadvantages; Time, Strength, Adaptation. Detail of Construction; Primary Band. Bite and Impression, Preparing Model, Casting Flasks, Dies, Forming Blanks, Swaging, Adapting and Re-enforcing. Reverse Process: Advantages, Disadvantages, Procedure; Original Model, Mould, Swaging-Model, Blanks, Swaging, Methods, Scott's Method, Finishing. Application to Separated Molar Roots; Procedure, Bands, Cusps. Application to Individual Roots. Cantilever Bridges. Application of Amalgam: With Band, Without Band. Application to the Anterior Teeth: Indications, Procedure; Adaptation to the Mouth. Adaptation to Models. Carving and Swaging. Die-plate Methods; Lowry and Millett Systems; Hollingsworth and Baird Systems. Seamless Method: Reproductions. Dowels. Ready-made Forms. Removing and Repairing; Crown Slitting Forceps. Preserving Continuity of Bands. Repairing.

Brief reference has already been made to the history and usefulness of the gold shell or telescope crown, and to this style of crown as having been one of the early achievements in the preservation of badly decayed teeth or roots, and the restoration to their former functional activity.

Regardless of the progress and development of crown work in general, however, and irrespective of the esthetic and hygienic advantages of porcelain work, this style of crown is still, and probably always will be, one of the very best means and methods of subserving the requirements. Indeed, when their application is indicated, and when the adaptation and construction, by whatever method chosen, is practically and skilfully executed, no other one method of procedure seems to offer so great an opportunity for the serviceable and permanent reproduction of the normal condition.

As a natural consequence, and because of the time-proven value of a method affording such opportunities and possessing the possible qualities of strength and indestructibility to so great an extent, many roots have been permanently saved and made useful that would otherwise have been lost; bridge-work, both fixed and removable in character, has developed and become practical; and yet the esthetic and artistic possibilities of modern prosthesis have been most flagrantly abused by injudicious use, and indiscriminate application.

If dentistry is to become universally acknowledged as a profession embracing a field of dignified and scientific pursuit, and if dental prosthesis is ever to be accorded the recognition and distinction of an *art*, to which the scope of its possibilities entitle it, the somewhat common practice of placing gold crowns on teeth, within the range of vision in the mouth, violating all traditions of art, must be considered as degrading, and should be most vigorously condemned.

No matter how skilfully the operation may be made, or how perfect the result obtained, such evidences of artificial handiwork whenever prominently conspicuous are an offense to art, culture and refinement.

As a result of the appreciation by the laity of more artistic endeavor, and their education at the hands of those conscientious enough to exercise their *duty*, the request for such work is now so limited, and so few will even tolerate them, that the pernicious practice is of necessity confined mostly to either unscrupulous charlatans, or to those who wilfully cater to a perverted taste and a barbaric vanity.

Indications.

As many teeth requiring artificial crowns, however, are beyond the range of vision, gold crowns may often be used without objection, and to the best possible advantage.

Their application is indicated, principally in restoring the roots of molars, and occasionally of second bicuspids, but rarely anterior to them.

In cases of close occlusion, where the cusps of the opposing teeth when brought into direct occlusion afford but little, if any opportunity for securing sufficient strength with any style of porcelain crown; and on roots so short, disintegrated and weakened as to require support and restoration with amalgam, especially in the mouths of men where their presence may not be conspicuous because of the beard, their application to the *first* bicuspids may be sometimes permissible; also in the preparation of bicuspids which are to serve as abutments for bridgework, where it seems advisable to allow the natural crown to remain as long as possible, in order to afford greater integrity in the attachment of the artificial crown, and thus secure increased mechanical resistance to the stress imposed upon the bridge.

Contraindications. Anterior to the molars, however, and particularly in the mouths of women, their application is usually contraindicated in view of the more artistic means available. Any exceptions should be based only upon a conscientious consideration of the existing conditions and practical requirements of the case; and their application to the incisors and cuspids, in any event, should be regarded as an unpardonable offense.

Requirements.

The requirements for this style of crown do not differ essentially from those of crown work in general, as previously outlined. Whenever and wherever employed, they should be constructed of a material thick and heavy enough to possess adequate strength *when finished,* and sufficiently high in karat to withstand the chemical action of the secretions.

Telescoping Portion. The band or that portion which telescopes the end of the root should fit closely around the entire circumference; pass a *short,* but *uniform,* distance beneath the gingival border of the gum, and possess a smooth *rounding* edge so as to offer no possible irritating influence to the tissues surrounding it. It should also be contoured to typical form, restore the points of contact, and preserve a proportionate and symmetrical alignment, with the adjacent teeth.

Occlusal End. The cusps forming the occlusal end should mimic or approach a typical reproduction of the individual tooth; restore the normal occlusion by contact with opposing teeth at several points, and offer no interference to the lateral motion of the jaw in the various movements of articulation.

They should also be deep and sharp enough to aid in the act of mastication, and of sufficient thickness to withstand constant and continued attrition.

A very common fault with a large majority of these crowns is the presentation of a more or less smooth and uninterrupted masticating surface. Such a condition precludes the proper mastication of food, and minimizes the possibilities of service and usefulness, which may be easily obtained, and which qualities such substitutes for the natural condition should always possess.

Methods.

The general usefulness of this style of crown has resulted in the presentation from time to time of an innumerable variety of methods and systems for their construction.

The degree of skill possessed by, and the personal preference of oper-

ators enter into the use of all of them to such an extent as to have so far prevented the adoption of any particular one as a universal system.

Two general methods of construction are employed—the *Sectional* and the *Seamless,* and each has many diversified processes.

Sectional Method.

The sectional method, wherein the band and cusp are made separately and subsequently united, is the most commonly used. This procedure seems to afford more absolute accuracy in securing adaptation; even better opportunities for the reproduction of the necessary contour; consumes less time, and admits of the use of a heavier gauge of gold throughout the construction of the crown. These important advantages cause it to be readily accepted as the most universally successful method.

The joint made in the union of band and cusp offers no objectionable features, and in no way interferes with artistic possibilities, if the edges

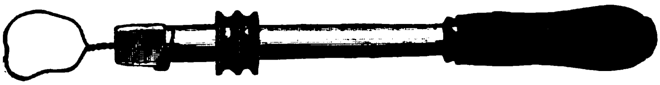


Fig.58.

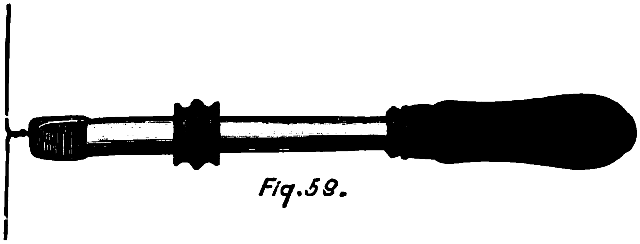


Fig.59.

of each are closely and perfectly approximated, and the union made with a solder closely resembling the gold in color, and sufficiently high in karat to withstand the chemical action of the secretions without subsequent discoloration.

Procedure.

In the procedure incident to the mechanical construction of a crown possessing a band by any method, the first detail is obviously that of securing a true measurement of the diameter of the root to serve as a positive guide in obtaining a band of accurate dimensions.

Measurement.

For this purpose wire, thin, narrow copper strips, and waxed floss are used. Bessemer steel wire, about No. 32, is preferable, however, because of being easier to adjust and handle, and more reliable.

It should be cut in suitable length, made in circular form, some what larger than the root, and the ends then securely attached in a small dentimeter, avoiding any unnecessary surplus.

While many varieties of dentimeters have been suggested, a small jeweler's slide pin-vise affords the quickest, easiest and most secure adjustment, with less danger of cutting the wire when twisting.

The loop of wire should be then placed over the root, passed just freely beneath the gingival border of the gum, and twisted taut, being careful in the meantime to conform and adapt it to all concavities of the root. Fig. 58.

In very short roots, it may become necessary to hold it under the gum with a suitable instrument, to prevent displacement while twisting; and, while it is usually most convenient to have the twist upon the buccal

Fig. 60.

or labial surfaces, in second and third molars it may sometimes be found more convenient to twist from the lingual surface.

After securing the correct measurement of the diameter of the root the wire should be cut in two at a point farthest away from the twisted portions, and each end of the former loop then carefully straightened out until smooth, continuous with one another, and at right angles with the dentimeter. Fig. 59.

When two or more crowns are being constructed for the same mouth at the same time, especially when the roots are nearly of a size, each measurement should possess some characteristic to distinguish it from the other, by which means any confusion in the subsequent fitting of the band may be avoided. This may be easily accomplished by so bending or shaping the surplus ends as to differentiate between them, and have each designate the root which it represents.

Bands. As the strength possessed by the crown, in its attachment to the root, increases in proportion to the thickness of the gold of which the band is made, so long as it is not *too* heavy to be easily manipulated and accurately adapted, and as gold stretches easily, and its thickness is necessarily diminished by the subsequent process of finishing and polishing, 28 gauge (B. & S.) plate, about 22 karat in fineness, should be used for bands. A gold for this purpose is especially prepared by the Consolidated Dental Mfg. Co. which is alloyed slightly with platinum, and possesses the advantages of strength and toughness as well as being non-oxidizable, by which name it is designated.

Width. The desired width of the band should be noted with the eye, or, if necessary, measured with a piece of cardboard trimmed to the correct width, or with a small compass. Fig. 60.

Length. In cutting the gold the cervical edge, or that which is to be fitted to the root, should be the *exact* length of the measurement wire; but the variation or

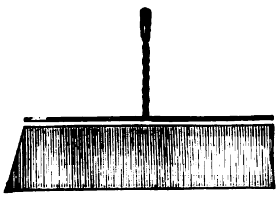


Fig. 61.

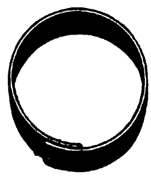


Fig. 62.

inequality between the diameter of the root, in proportion to the dimensions of the space to be filled by the crown, to obtain the most artistic results, often requires that one end of the band be cut on such an angle as to make a difference between the circumference of its cervical and occlusal edges when soldered. Fig. 61.

While perfectly straight edges will often afford sufficient opportunity for the necessary shaping and contouring of the occlusal end, it is frequently desirable and sometimes necessary to have this edge of slightly larger proportions, especially in bicuspids, in order to more perfectly and artistically meet the requirements of contact and alignment.

Where the root is proportionately larger than the space to be filled, however, the converse of the proposition may be indicated, in order to secure and preserve an alignment of the occlusal surfaces. In such in-

stances the edges should be cut *straight,* in order to facilitate the adaptation to the root, after which the circumference of the occlusal edge may be adequately reduced.

Soldering. When the band has been properly cut it should be annealed, the edges filed smooth, so as to approximate evenly when brought into contact, and then given circular form. Perfect contact of the edges is essential to insure fit and facilitate soldering, and may be sustained by first *overlapping* and then bringing them back into direct contact. (Fig. 62.) This procedure condenses the molecules sufficiently to overcome the expansion, when heated, that would otherwise cause a separation, and is preferable to wir-

In soldering, it should be held in the flame so that each edge will be uniformly heated, because if either should receive a preponderance of heat the solder would become attached to it, and the addition of a second piece may be necessary. Any more solder than is required to make the joint is objectional because of the additional stiffness imparted to the band.

As it is desirable to begin with a high grade of solder to prevent subsequent re-fusing, and to admit of finishing with as high a karat as possible, all bands should usually be united with 22 karat solder, though 20 karat will answer the purpose.

For convenience and comfort, the pliers used to hold the work in the flame should possess a long handle and thin tapering points. (Fig. 64.) The addition of platinum points, which may be easily attached with any hard solder, increases their usefulness, as such pliers absorb less heat, retain their shape more permanently, and offer more resistance to the attachment of solder.

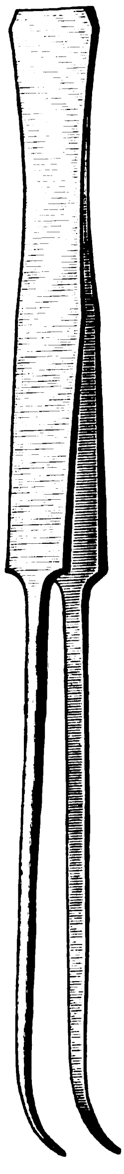


Fig. 64.

Fitting.

The fitting of the band may be made accurate, easy and devoid of discomfiture, in proportion to the relation it bears to the shape of the root and to the outline of its surrounding tissue, *before any attempt is made to adjust it.* The detail of requirements in this connection apply to any style of crown with a band, and are,

First—To conform the band to the general shape and outline of the root.

Second—To trim the edge which is to pass beneath the tissue to *closely follow* the cervical curvature of the process, and gingival festoon of the gum, so that it will come in contact *evenly* and *uniformly* at all points, before the final necessary pressure is applied.

Third—To *round* and *smooth* the edge so that no irritating influence will be offered in forcing it beneath the gum.

Fourth—For the purpose of convenience and of avoiding any confusion in *adjusting* and *readjusting;* because the usual convexity of roots at this point facilitates the adaptation of the stiffened portion of the band, and because of placing the soldered joint where it will be least conspicuous in case of subsequent discoloration, as well as being most easily accessible for reinforcement in the assemblage of bridgework, the joint in the band should *always* be placed at the *center* of the *lingual surface* of the root.

A neglect of any of these most essential features adds materially to the difficulties experienced in, and the possible discomfitures resultant from, the operation. In observing them the band should be gently placed over the projecting end of the root, and shaped with pliers until it is made to conform to its general outline, and any existing concavities or inequalities. Its surfaces should be made perpendicular, and the edge then carefully trimmed with curved pointed shears until it meets the gum line *evenly* at all points; and then nicely *rounded* from the outer surface with a fine half-round file, until blunt but smooth. This minimizes the pos-

sibilities of irritation, without obtaining any apreciable thinness of the gold which would be objectionable because of increasing the liabilities of stretching and irritation.

When these requirements have been complied with, the band should be placed upon the root, and gently pressed to place until the edge passes *just freely* beneath the tissue. For this purpose a small piece of wood of convenient size, with flat, smooth surfaces, is most useful; and if properly used greatly facilitates the operation, and obviates the *driving* of a band into place, which is entirely unnecessary, and even *brutal.*

In instances where a recession of the gingival border of the gum may have exposed the root beyond the normal outline at some point, such as is not infrequently found to present in the mesio-buccal and lingual roots of upper molars, an extension to the band may be indicated in preference to sacrificing it upon other surfaces sufficiently to admit of thus approaching the gum at this point. This may be best accomplished by first fitting the

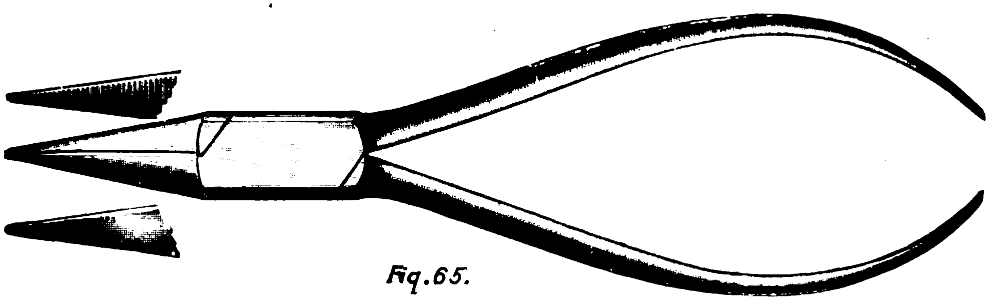


Fig. 65.

band accurately without regard to this extension, after which a small piece of pure gold plate may be soldered to the outer surface of the band, and then trimmed until this denuded portion of the root is covered. When the necessary burnishing has been completed, the adaptation may be sustained by re-enforcing the extension with a high grade of solder.

When the cervical adaptation has been completed, the occlusal edge should be trimmed to afford accommodation for the adjustment of a cusp of uniform and sufficient depth, and then filed smooth and contoured.

Contouring. The entire artistic effect of the finished crown, as well as the prerequisites of contact and alignment, depends in a great measure upon the form and shape given to the occlusal end of the band, which can be *best* observed at this time.

By *contouring* is meant the reproduction of the natural form and outline of the tooth, and while this may be accomplished with solder,

after the cusps have been united, much time, energy and material can be saved, and far more artistic results obtained, by properly shaping the band itself.

Artistic results in this connection, however, are made possible only by a thorough knowledge of the angles, characteristics and general forms of the natural teeth, the outlines of which should be reproduced in this edge of the band. This may be done irrespective of the necessary shape of the cervical edge in its adaptation to the root, and without change of it.

Fig. 66.

For contouring purposes various styles and designs of pliers are used, but as the shaping should be done upon the edge of the band, before the cusp is attached, all of the necessary and artistic results may be easily accomplished with pliers, the beaks of which are straight, tapering, and come closely together, with rounded edges. A design of the author's for this purpose and for universal use in crown work is illustrated in Fig. 65, and, while some of the numerous other designs may be found occasionally useful, these will meet the general requirements, when properly used.

The rounded edges and one smooth beak prevent defacing the gold, while the flat surfaces and one serrated beak, and the tapering form for stretching, adds to their general usefulness.

The average and typical requirements, and the results possible from a knowledge of the form and outline of the teeth, and a skilful manipulation of the pliers, are indicated before and after contouring the band in Fig. 66.

In instances where the diameter of the root after its preparation is larger than the proportionate dimensions of the occlusal surface, to secure a symmetrical alignment with the adjacent teeth it may become necessary to reduce the circumference of the occlusal edge of the band. This may be quite easily accomplished by cutting numerous slits around the approximal and lingual surfaces of the occlusal edge, and then drawing the points in and overlapping them until the circumference is sufficiently reduced. (Fig. 67.) These places may be afterwards filled in

Fig. 67.

with solder until a smooth uninterrupted surface presents. Although the pliers previously mentioned may be used successfully, a very convenient form especially adapted to this purpose, and generally useful in reducing the size of either end of the band, when occasion requires, is illustrated in Fig. 68.

After securing the proper and desired contour, this edge should be filed smooth and even, the band then finally adjusted to the root, and the occluding bite and impression taken.

Occluding Bite.

The interior of the band should be filled even with the edge with wax previous to taking the occluding bite. This facilitates the removal of the latter from the mouth and its final adjustment to the model.

The occluding bite should always be taken separately from the impression, and should *precede* it, because the imprint of the band is necessary to admit of its adjustment to the model with the band in place. Wax

is preferable for this purpose, because of the ease with which the relation and a good imprint of the teeth may be secured, and of its more easy and accurate adjustment to the model.

In obtaining it enough wax should be used to secure the imprint of at least two teeth on each side of the crown, whenever possible, and in the procedure it should be definitely ascertained that the teeth are in *direct* and *proper occlusion.*

The patient should then be instructed to firmly close the jaw, and press the wax against the lingual surfaces of the teeth with the tongue, when by compressing it closely to the buccal surfaces with the fingers a correct and well-defined bite is readily obtained.

Impression. The impression should *always* be taken with plaster, and, corresponding with the bite, should include two or more adjacent teeth, when present, on each side of the crown. This is necessary in order to prove and govern

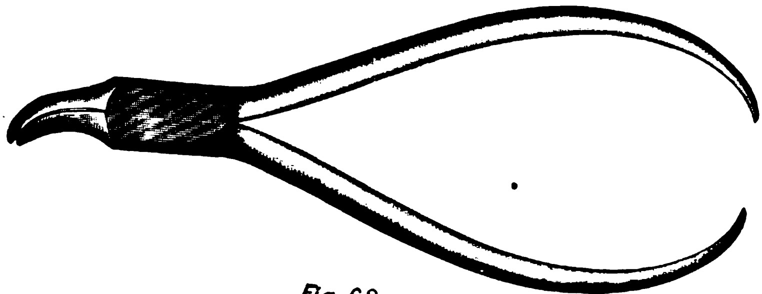


Fig. 68.

the occlusion when mounted upon the articulator. The use of plaster is essential for this purpose, because of the difficulty of, and uncertainty in readjusting the band to its accurate position in the impression, when any material is used which *draws* perceptibly in removing from the mouth. This may be done with a degree of absolute certainty when plaster is used.

Partial impression trays of convenient size for this purpose are illustrated in Fig. 69, two being adapted for the right and left sides, and one for universal use; the latter, of course, is the most generally useful. Because of the natural shape of the teeth, it will usually be found necessary to break the impression in removing it from the mouth, which is not objectionable if the parts are afterward accurately replaced. A

convenient tray, recently designed by Dr. E. L. Townsend to facilitate such procedure, includes a separable base composed of two smaller trays with the dividing line in the center. Upon the removal of the outer tray these remain in place, when they may be easily divided by the insertion of the blade of a small penknife, which separates the impression in two lateral halves. (Fig. 70.)

When the parts are accurately readjusted and their relation securely sustained with melted wax, the impression should be then varnished, filled, separated, the bite adjusted, and then mounted securely upon the articulator. For the purpose of facilitating the separation of the model

from the impression, the latter should be first coated with a *thin* solution of shellac in alcohol, and followed, after drying, with a coating of very thin sandarac, in alcohol. The former causes a line of demarcation of inestimable value in separating, and the latter gives a smooth, hard surface to the model.

Articulators. Because of the desirability of obtaining a degree of accuracy in articulation as well as occlusion, a reproduction of the lateral movements of the jaw, such as are made possible by the use of an anatomical articulator, is almost as essential in crown work as it is in the construction of artificial dentures.

Fig. 70.

For single crowns, however, such requirements, while always desirable, are not so essentially necessary, and in the absence of a design more conveniently adequate for the purpose, the ordinary crown articulator may answer. (Fig. 71.)

Fig. 71.

Processes for Cusp Formation.

Of the various methods and systems for securing suitable cusp forms that will typify the natural teeth, and meet the requirements of articula-

tion and occlusion, but *one* general line of procedure offers absolute certainty and accuracy in all cases.

The importance of true occlusion, as has been previously emphasized, will be readily apparent, and is generally conceded, and yet throughout the entire evolution of methods for procuring it, a system of stereotyped typical dies has predominated. As the conditions presenting vary in proportion to the degree of the normal accuracy of occlusion, position of the root, and its relation to adjacent teeth, and the length and shape of band and depth of cusp required, the fallacy of expecting a ready-made form to closely fit and approximate the edge of a properly contoured band, and then articulate and occlude accurately with the opposing teeth, is manifest.

Carved Cusp and Special Die Methods.

If these mechanical and artistic requirements are to be observed, the prerequisites of certainty and accuracy can be best obtained by forming

Fig. 72.

the cusp directly from an imprint of the opposing teeth, and in its proper relation to the band, as was originally suggested in primitive form by Dr. Norman W. Kingsley. While the detail of such a procedure may probably consume a little more time than some methods, *time* is not the only factor to be considered, except perhaps by *dental laboratories;* and the results will usually justify such an expenditure.

Procedure

When the models have been securely mounted upon the articulator (Fig. 72), all surfaces of the plaster in close proximity to the band should be varnished with a *thin* coating of collodion, sandarac or silex. The band

should now be filled with thin, well mixed plaster, into which the occusal surfaces of the opposing teeth are then imprinted by firmly closing the articulator. (Fig. 73.) The reproduction of adjacent teeth in the model serves to sustain and prove the proper occlusion. When this has become sufficiently crystallized, the articulator should be opened, and the band, with its plaster contents, detached from the model in such manner as to preserve its definite outline and relation. The surplus plaster around the

Fig. 73.

outer edge of the band should be removed with the sharp blade of a small penknife, which leaves the remaining contents somewhat crude and inartistic in outline, but accurate in occlusion. (Fig. 74.) An artistic effect, in proportion to the degree of skill possessed by the operator, may be obtained by inserting the grooves and pits of the typical outline

Fig. 74. Fig. 75.

of the tooth, which may be done without perceptible change to the occlusion. In fact, the latter is thus improved because of the formation and separation of the cusps. (Fig. 75.)

While modeling compound, mouldine and wax are sometimes employed for the formation of cusps, the use of any of them is not so reliable as plaster, because of the tendency to flake in carving, or of the susceptibility to change form in the subsequent process of securing the mould for

the die, or for casting. In the process of carving, it is not altogether necessary that the *correct anatomical* outline of the tooth should be reproduced, but only to typify it sufficiently to designate the tooth it represents. This may be easily accomplished by inserting the grooves *deep* enough to separate the cusps, and typical enough in outline to distinguish the *right* from the *left,* and the *upper from the lower.* (Fig. 76.)

In the reproduction of the plaster cusp in gold, two methods of procedure are employed, by means of which plate gold may be conformed by swaging between dies, or a solid cusp produced by casting.

Swaged Cusps. Because of the possibilities for securing a more distinct and definite reproduction of the outline; of the time saved in adjusting and adapting the cusp to the band, and of securing adequate thickness of cusp by subsequent re-

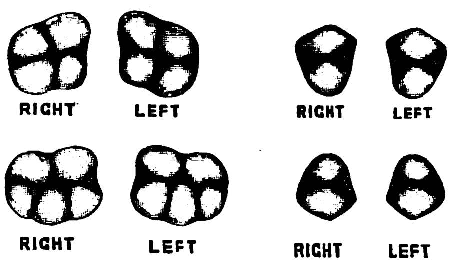


Fig. 76.

enforcement with solder, the swaged method is usually preferable.

For this procedure the *plaster cusp* should be trimmed away uniformly around its peripheral border, until the edge of the band is exposed. This reduction in size allows for the thickness of gold forming the cusp, and renders possible a *perfect approximation* of the edges of cusp and band. If not observed, the cusp will be as much larger than the band as its thickness, which will require the use of solder in securing a smooth surface in its subsequent attachment.

Mould. A moulding ring (Fig. 77) should be filled even and flush to its edges with mouldine, into the center of one surface of which the plaster cusp, after being dusted with lycopodium or soapstone, should be firmly imprinted *just deep enough* to secure the outline of the exposed edge of the band. The mouldine should be packed closely against the band around its circumference, and the band and plaster cusp removed from the

mould. This should be dusted with lycopodium and the dies secured.

Dies.

The most useful and convenient system of dies may be secured by placing a casting cup (Fig. 78), which has a small perforation through the center of the base, over the mould, and casting a cusp-button of pure tin or Watt's metal (Fig. 79). After cooling, the button should be detached from the cup with a small knife-blade, and placed upon a smooth surface of mould-

Fig. 78.

Fig. 79.

Fig. 80.

Fig. 81.

Fig. 82.

ine, in the moulding ring, then dusted freely with lycopodium, and the rubber ring adjusted for the purpose of securing the counter-die (Fig. 80), which is poured with fusible alloy.

A higher fusing metal than any of the fusible alloys is necessary for casting the cusp-button in order to preclude the probability of melting it in securing the counter-die.

In the process of forming the cusp with these dies (Fig. 81), the swaging should be done in the counter-die by the use of an ingot of lead, *or a large buckshot,* until closely adapted, after which the surplus gold should be cut away and the cusp-button used for the final swaging only, to bring out the finer lines. These cusp-buttons may be preserved and found useful wherever occasion admits of the use of ordinary and typical dies, such, for instance, as the absence of occluding and adjacent teeth.

Another method somewhat more simple is to secure the mould as indicated, and then adjust the rubber ring and pour the die of fusible alloy. The surface is then dusted with lycopodium or coated with a solution of whiting in alcohol, the rubber ring readjusted, and a counter-die of the same metal and dimensions secured. (Fig. 82.)

While this will answer the purpose, if the swaging is done in similar manner, the tendency of stretching and probability of tearing the gold

Fig. 83.

will be increased, especially if the cusp is very deep, because of the difficulty of swaging and conforming gold, or any metal, to any given or desired shape between two surfaces of like and equal resistance, in which respect lies the advantage of the former method.

Swaging.

In the process of swaging, the surfaces of the dies should be *oiled* to facilitate the procedure, and prevent sticking. A convenient method of preventing the defacing of the gold is to stretch a piece of rubber dam over it before driving into the counter die. This also avoids any coating of the die metal from adhering to the surface of the gold. The chances of tearing the gold may be reduced to a minimum by first swaging a few layers of heavy tinfoil covered by the rubber dam. This slightly compresses the metals and affords space for the gold between the two surfaces of the dies, and it should first be carefully worked down into the counter die with

a small blunt-pointed piece of wood. The gold used should be of the same karat and color as the band, and of 28 gauge thickness, as it is to be subjected to considerable stretching. It should be cut somewhat larger than the diameter of the cusp to be formed, and frequently annealed during the process; and a round or disk-shaped piece of plate will yield more readily to the desired conformation between the dies, with less tendency to overlap at the angles; and all unnecessary surplus should be removed *before* the *final* swaging. Steady and uniform pressure, such as would result from the use of a press of adequate power, would be productive of better results, in the absence of which a *heavy* hammer and direct blow will answer.

Adjusting Cusp. When the swaging has been completed, the edge of cusp should be carefully trimmed down to the line marking its point of contact with the band, which should be outlined in the gold. This point can be approached with small curved crown shears, but the final trimming should be done with a fine flat-surface gold file, and may be best and more uniformly accomplished by holding the file steady and carrying the cusp backward and forward over its surface. The plaster cusp should then be removed from the band, and the latter adjusted to place on the articulator. After filling the interior of the band with wax to sustain the cusp, it should be consecutively trimmed and tried to place until the edges approximate evenly, and the desired occlusion is obtained and proven by the firm closure of the articulator. (Fig. 83.)

Soldering Cusp. The necessary re-enforcement of the cusp to fortify it against constant and continued attrition may be done with solder simultaneously with its attachment to the band, although no objection is offered to filling the cusp with solder previous to its

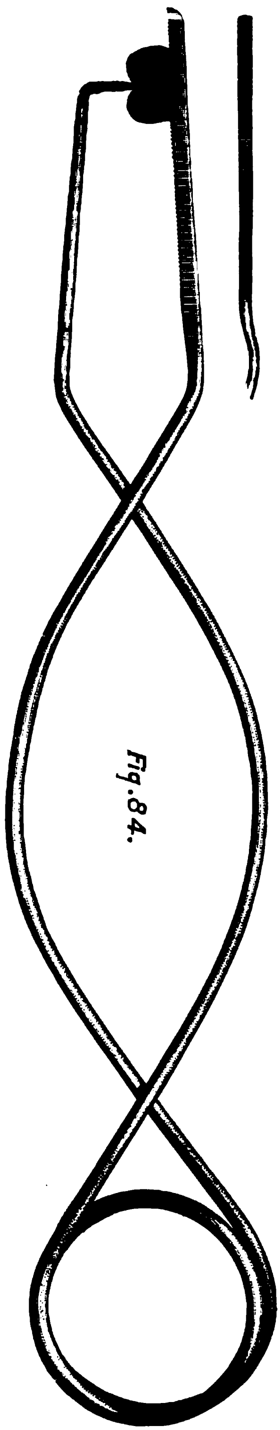


Fig. 84.

subsequent attachment if done with the same karat that would be indicated and used in the joint. During the process of soldering, the relation between cusp and band should be securely sustained. This can be best accomplished by the use of automatic pliers designed for the purpose as indicated in Fig. 84, the use of wire being objectionable for the same reasons previously mentioned in connection with soldering the band.

The parts should be treated to the acid bath, freely washed with water, and adjusted in the pliers. Flux should then be applied to the joint and fused, and the parts united with 22 or 20 karat solder. The necessary re-enforcement may be obtained with 18 karat solder. In case of a perforation of the gold as a result of swaging, the same should be first

Fig. 85.

filled with foil, when no trouble will be experienced in covering it over or filling it in with solder.

Finishing. When the soldering has been completed, the crown should be again treated to the acid bath to dissolve remaining borax, then dressed down with carborundum stones and disks in the engine, and finally polished on the lathe.

Solid Cast Cusps. While no special or particular advantage is afforded by the formation of a solid or cast cusp, excepting that the presentation of a faulty or inaccurate occlusion may be remedied by grinding freely without exposing the solder, yet many prefer to pursue this method. When such procedure seems desirable, the plaster cusp, after carving, should be left *flush* and *continuous* with the *outside* edge of the band.

The moulding ring should be filled with mouldine, and the mould of the cusp secured on a line with the edge of the band. This should then

be placed over the Bunsen burner and allowed to remain until the mouldine becomes hard. Asbestos of adequate thickness to accommodate the depth of the cusp may also be used for the mould by saturating it with water until a suitable imprint of the plaster cusp can be made in it, after which it should be dried in the same manner. Scrap gold of sufficient quantity, sparingly fluxed, should be fused in the mould, and, when molten, may be easily cast by quickly pressing it into the matrix with a smooth surface of carbon or steel large enough to cover the entire area of the cusp. (Fig. 85.) The principal objection offered to this method is the time ordinarily required to trim and file the surface until a perfect approximation with the band, and the necessary requirements of occlusion are obtained. Such cusps may also be cast by Dr. Taggart's method.

Cusp Formation without Models.

The same detail of procedure is applicable to the formation of cusps without the use of models or articulator. The results, however, while perhaps occasionally as artistic, are not so accurate, because no guide for

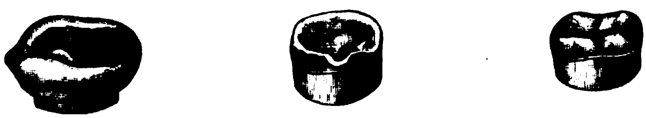


Fig. 86.

obtaining the correct length of cusps is present, and no opportunity is afforded for *proving* the articulation and occlusion in the final adjustment and attachment of the cusps to the band, unless it be done directly in the mouth.

When the employment of such a procedure may seem indicated, or when it may be desirable or necessary to complete the crown at a single sitting, the band in position on the root may be filled with a sufficient quantity of plaster, in the plastic state, or with modeling compound, and the teeth closed directly into it. After thoroughly hardening it should be removed, the surplus trimmed away even with the band, and the desired and typical shape and form then given it by carving, as is consecutively illustrated in Fig. 86, when the dies or mould may be obtained in the manner outlined, and the crown finished, as indicated.

Ash's Crown Swaging Device.

Ash's crown swaging device, which consists of a cylinder and plunger, and a *soft* rubber or hydraulic pad, will be found quite useful

for swaged cusps, because of eliminating the necessity for the use of any counter-die, or of swaging between two surfaces of metal, and, by preventing any rebound, displacement or defacing of the gold during the process.

In its use the mould from which the die is secured must be obtained in a moulding ring of suitable dimensions, to render it of a size corresponding to the interior diameter of the cylinder. These are included in an outfit suggested by Dr. E. G. Christiansen, of Dremmen, Norway, and manufactured by C. Ash & Sons.

Fig. 87.

When the die has been secured with fusible alloy it should be placed in the cylinder, the gold annealed and placed in position, and the soft rubber or hydraulic pad then inserted.

The plunger is then adjusted, and, upon being driven into the cylinder, results in the swaging being easily and quickly accomplished, without danger of tearing or defacing the gold.

If the cusp-button method of dies has been employed, and the button afterward used only to bring out the finer and more definite lines, the swaging may be done in the counter die in the same manner (Fig. 87).

Die and Die-Plate Methods.

The advent of the die and the die-plate systems was, primarily, the outcome of a desire for obtaining more natural and artistic results in the process of cusp-formation than was then possible by pursuing the primitive method. Originally, efforts in this line were confined to soldering a flat surface of gold to the band, and then building the cusps at various points upon this surface with small globules of scrap gold, or pieces of triangular platino-iridium wire, attached with solder; or with solder alone, and subsequently grinding to the desired form and occlusion.

While many of these somewhat crude, inaccurate and inartistic efforts were successful from the standpoint of serviceability and usefulness, the introduction of dies soon followed. These were designed to serve as a means of securing more artistic results, and as a time-saving procedure.

Individual Dies.

The first productions in this line were individual dies, obtained directly from the natural teeth. For this purpose suitable extracted teeth were selected, and mounted in a base of plaster. This was then trimmed to favorable shape for securing a mould in sand, from which a casting was made of zinc.

Plate gold was then swaged to conform with the outlines of the natural cusps by driving the die into a smooth surface of lead, or an old discarded counter-die.

This method was productive of so great a degree of improvement over the former procedure as to subsequently induce the supply-houses to manufacture these dies in sets of various numbers, and made of brass in order to be more permanent and indestructible (Fig. 88).

Fig. 88.

Die-Plates.

Because of the immediate necessity for a suitable counter-die, and of the advantage of combining a larger variety of cusp-forms into more convenient and compact order, the introduction of the die-plate was a natural sequence.

These comprise various numbers of cusp-moulds in a *brass* or *steel* casting. In their use the swaging is easily and quickly accomplished by driving the disk of gold into the mould selected to best approach the requirements, with an ingot of lead or alloy of lead and tin. Ingots for the purpose may be previously cast in any quantity, and of adequate and convenient sizes by the use of a *hub-mould* designed for, and usually accompanying, the die-plate (Fig. 89). Ordinary buckshot, however, are easy

to procure, and, if of suitable size, will answer the purpose nicely. The steel plates may also be thus employed, or may be used to produce solid cusps by driving an ingot of scrap gold into the mould selected.

While these plates are still in common use their value and range of application increases in proportion to the number and variety of cusp-forms contained, and their limitations, of course, decrease in inverse ratio.

Application.

In their use the mould should be selected which best represents the individual tooth to be crowned, and meets or approaches the size of the band. The requirements of occlusion must be secured in the fitting and adjustment of the cusps to the band, which can only be observed, of course, after swaging the cusps.

Adjusting with Models.

With cusps formed by *any* die-plate system or method the best and most accurate relation can be secured with models mounted upon the articulator. Opportunity is thus afforded for trimming the band

Fig. 89.

or the cusps, until their approximation admits of a favorable occlusion, which can be noted upon the lingual as well as the buccal surfaces.

More perfect occlusion may often be obtained by depressing the cusps with a blunt instrument, or piece of wood; or, if necessary, by building up, wherever indicated, with a *high grade* of solder. Small globules of scrap gold or pieces of gold or platinum wire facilitate such procedure by affording a guide as to the desired formation and location, and by requiring the control of less solder in their attachment.

When the requirements of occlusion have been thus observed, an effort should be made to closely approximate the edges of cusps and band. This may be done by adjusting the one to the other with pliers, if care be exercised so as not to distort the shape of the band and destroy its contact and alignment. Any necessary filling in or subsequent contouring may be done with solder in the final attachment. Where a considerable space exists between the two portions, the process of soldering is facilitated by burnishing a piece of thin pure gold plate, or packing foil gold into such spaces.

Adjusting without Models.

In emergencies, or where it may seem desirable to complete the crown without models, and secure the adjustment in the mouth, the fitting may be facilitated by filling the interior of the band with wax to temporarily sustain the cusps during the process. When the parts have been approximated, a more perfect occlusion may often be obtained by tacking the cusps to the band at one point with a very small bit of solder, and then replacing the crown and having the opposing teeth closed firmly into it, after which the soldering may be completed, and the necessary reinforcement given. If the requirements are particularly difficult, the process may be further facilitated by swaging the cusps of 30 gauge pure gold. This is so much more yielding and will offer so little resistance to the closure of the teeth into firm occlusion, as to insure moderately accurate results, but such cusps should be attached with a very high grade of solder, as the extreme softness of the gold will soon result in its exposure. This procedure is equally applicable, of course, to the adjustment of cusps formed by any system or method employed.

Hollingsworth System.

The great variation in the size, shape and depth of cusps necessary to meet or approach the requirements of this style of crown construction, and the previous absence of any system, or definite detail in the work, resulted in the introduction of the Hollingsworth System, devised by Dr. J. G. Hollingsworth.

This was the first system embracing a detailed line of procedure in the construction of gold crowns, and because of including a large variety and selection of typical forms, of its simplicity, and of being so great an improvement over former methods, it is much used.

It comprises about two hundred typical occlusal forms in the shape of cusp-buttons, and a good selection of moulds of the buccal surfaces of bicuspids and molars, and of the labial and lingual surfaces of the anterior teeth.

Those for the buccal surfaces of bicuspids and molars are designed for the purpose of securing a more artistic shape in these surfaces of the band by swaging, or for gold reproductions of the entire tooth. For the former purpose, however, such procedure by any system is unnecessary, because of the time consumed, and of the possibilities for otherwise, and more quickly securing a proper and equally artistic shape. While such moulds may often be found useful for obtaining all gold dummies for bridge construction, those for the anterior teeth are practically useless, because of the limited indications for the application of such crowns.

The variety, form and convenient shape of the cusp-buttons, how-

ever, affords for them a more or less extensive range of application and usefulness. They are made of a metal which is moderately indestructible, and are used only for the purpose of forming the die for the subsequent conformation of the gold by swaging, or for securing the mould in asbestos for the purpose of obtaining solid cast cusps, as previously indicated.

The convenient size of the cusp-buttons possesses the advantage of facilitating the selection of the one most favorable to meet the requirements, which may be accomplished by trying to place upon the band, on the articulator, or in the mouth.

Aside from the forms, the system consists of a steel moulding plate and suitable rubber moulding rings.

Application. When the cusp-button which *best* represents the tooth, and meets the requirements of occlusion and approximation with the edge of band, has been selected, it should be deposited upon the moulding plate, and the rubber ring placed around it. Fusible alloy should be then melted and poured into the ring. In pouring, it should be directed immediately upon the center of the cusp-button, in order to prevent an imperfect die, or one not entirely surrounded with metal.

When the fusible alloy has crystallized, it should be cooled by dipping into water, and the rubber ring then detached. The cusp-button may be then easily separated by gently tapping, and replaced in the tray, and the die is ready for the swaging of the gold. This is accomplished in the manner indicated, by the use of a buckshot, or ingot of lead, driven to place with a swaging hammer, after which the surplus may be trimmed away, and the cusps finally adjusted to proper relation with the band and occlusion, and then soldered.

The use of these cusp-buttons offers the additional advantage of affording opportunity for modifying or improving the occlusion when indicated, by building the cusps up with mouldine at the desired points, and to the desired depth, before pouring the die. Also, in cases where the band may be so short as to require a deeper cusp, this may be easily secured by raising the cusp-button on the moulding plate with a base of mouldine of sufficient thickness to make up the deficiency in depth, and trimmed to closely follow the outline, before pouring the die.

Millett's System.

One of the most modern inventions in die-plates, and processes of swaging, and one possessing some new and good features, has been recently introduced in Millett's System.

This consists of a large die-plate comprising about four hundred raised moulds of cusp-forms, and buccal and labial surfaces, systemati-

cally arranged in sizes, and for each side of the mouth, and the necessary apparatus for swaging.

While the forms are similar in size and shape to those of the Hollingsworth System, the die-plate offers a greater range of application in a larger variety for selection, and the advantage of each one being an integral part of the plate, which overcomes the possibility of the disarrangement or loss of any of them.

This, together with the method of securing the die, and the process of swaging, without doubt affords greater simplicity and quicker results, but the important feature of not being able to adjust the cusp-forms to position on the band, as an aid in their proper selection, is a disadvantage.

The apparatus for swaging includes a cylinder and plunger, and a bed-plate and soft rubber block, which are similar to Ash's crown swaging outfit.

Application. The bed-plate is designed for the purpose of holding a sufficient quantity of ordinary sealing-wax to secure a die of any of the individual moulds, and fits accurately in the cylinder.

The sealing-wax contained in the bed-plate is softened by passing through a flame, and then pressed firmly over the form selected to be duplicated in gold, and which is *calculated* to be the nearest approach to the requirements.

This gives an accurate impression of the form, in the wax, which, after chilling in cold water, is sufficiently hard to answer the purpose of a die.

This is placed in the cylinder, the gold annealed and placed on top of it, the soft rubber block inserted, the plunger placed over all, and the swaging accomplished by driving the plunger into the cylinder with a moderately heavy swaging hammer.

In cases where a deeper cusp-form is desired, or necessary, a rim of warm sealing-wax may be moulded around the edge of the imprint until sufficient increase of depth is obtained, before swaging. Where a more shallow reproduction is indicated, the sealing-wax may be trimmed or pared down accordingly; or, if the summits of one or more of the individual points or cusps need to be made more pronounced, the die may be deepened at such points with a sharp bur or suitably shaped cutting instrument.

Lowry System.

This system, devised by Dr. H. S. Lowry, departs from other methods where moulds are used, and, like the original die-plates, comprises the actual dies to be used in the process of swaging.

The improvement lies in the more extensive selection, and the supplemental *trial caps* which represent the exact size and formation of the dies.

The dies are individual in character, made of a practically indestructible metal, and each one is numbered. The trial caps are numbered corresponding with the dies of which they are counterparts, and are provided with a projecting stem, which facilities holding and handling them in their adjustment to the band, in the process of selecting the one best suited to the requirements.

The system includes a moderately good selection of about sixty dies of cusp-forms; and a smaller number of the buccal surfaces of bicuspids and molars, and the labial surfaces of the anterior teeth, with corresponding complement dies, together with a "stamper" for swaging, and soldering pliers for general use.

Application. The trial caps are adjusted to position on the band, until a selection is made of the one which best meets the requirements. The number of this is noted, and the corresponding die selected. The surface of the die should then be slightly oiled, and the gold cut, annealed, and placed over it, and then adjusted to position in the "stamper." A buckshot or piece of lead of suitable proportions should then be placed upon the gold, and the plunger of the "stamper" brought in contact.

The plunger is held quite securely in any position by means of frictional contact, which facilitates the swaging in preventing the rebounding of the die, or the slipping or moving of the gold or lead during the process of driving it down by the use of a swaging hammer.

A special die, containing two depressions of different sizes, is provided for improving the occlusion when indicated, by lengthening or deepening the cusps at any desired point. After the cusps have been swaged, the point to be raised or deepened should be placed over the hole, and further swaged to the necessary extent by the use of a blunt piece of wood of suitable size.

Baird System.

Another recent device in this line is the system and method designed by Dr. W. H. Baird.

This consists of a heavy pair of swaging pliers, with parallel jaws, one of which is grooved to admit of slides which support the dies.

The dies are raised and individual in character, made of a comparatively indestructible metal, and include about two hundred and fifty moderately good forms. These comprise a good selection of *cusp-forms*, and

a proportionate number of the buccal surfaces of bicuspids and molars, and the labial and lingual surfaces of the anterior teeth.

Application. When the selection of the form calculated to best meet the requirements has been made, it is then placed in position on the slide, and the latter adjusted to the grooves in the pliers.

The gold is then annealed, placed upon the die, and covered with a pad of soft rubber, or piece of sheet lead of adequate thickness (about 3-16 of an inch), and dimensions, to serve as a counter-die. The pliers are then closed and held together with sufficient firmness to prevent any rebound during the process of swaging, which is accomplished with a hammer.

The flat base to each die precludes any opportunity for accurately adjusting to the band, in making the selection; and the system affords no provision for altering the cusp reproductions to more perfectly meet the requirements of occlusion, depending upon the variety and general application of the dies for this purpose.

Seamless Method.

The seamless method comprises forming the entire crown with one piece of gold, by swaging, and, while many *systems* for this particular style of construction have been devised, and are used, a close observation of the relative advantages and disadvantages as compared with the sectional method fails to afford any real or practical evidences of special merit in this process.

It is claimed by those using and advocating this method that a closer reproduction of the natural tooth form is possible, and that greater opportunities for more pronounced contouring are afforded, from which assertions it is deduced that more artistic results may be obtained.

As such results *from any method of procedure,* however, are *equally* dependent upon the skill, ability and conscientious efforts of the operator, and, as the presence of a joint between cusp and band is in no way objectionable if the prerequisites previously mentioned have been observed, any actual or *practical* foundation for such a claim is scarcely apparent.

If it were still necessary to depend upon a *limited* selection of cusp forms, which were difficult to adapt to the average properly contoured band without the use of considerable solder and much filling in, some advantage might be possessed by a method which would afford a smooth continuous crown, but, in view of the possibilities already outlined in this connection, the real value of the seamless method will doubtless always remain more appreciable to the "dental laboratories," and others commercially interested, than to the average practitioner of ordinary skill.

Advantages. A summary of the possible advantages of this method presents but two special features: First, the opportunities for obtaining contour, and, second, the absence of a joint or seam of solder at any point.

The *first* feature needs no consideration, because, as has been previously asserted, the possibilities of, and opportunities for, contouring, are not entirely dependent upon the process employed, and in no way exceed those offered by the sectional method in so far as the actual requirements are concerned.

In considering the *second* feature, the absence of a joint or seam of solder may be proclaimed as an advantage in *three* instances of detail. First, in eliminating the possibilities of the subsequent discoloration of the solder in the joint, when subjected to the action of the secretions. Second, in the construction of a platinum crown which is to serve as an abutment for porcelain bridgework. Third, in the construction of a gold crown for the bicuspids where a porcelain facing is to be subsequently inserted.

In the *first* instance, if the edges to be united are *closely fitted* and *approximated,* the quantity of solder in the joint is so infinitesimal that if a high grade of similar color be used, and the crown then well finished and polished, no opportunity will be offered for any subsequent discoloration; hence, no special advantage is apparent.

In the *second* instance the same advantage may be readily obtained by permanently overlapping the edges of the band in making the joint, and closely approximating the edges of cusp and band, and then using *platinum solder* in their union. This will preclude the re-fusing or unsoldering of the parts in the furnace during the process of fusing the porcelain; and the additional thickness of platinum which may be used when the sectional method is employed adds materially to the necessary strength which such a crown must possess in that particular portion of it *which surrounds the root.*

In the *third* instance the advantage is perhaps *least* imaginary, but if the joints of the sectional crown intended for such a purpose are made as has been indicated, the subsequent attachment of the facing with a lower grade of solder may be done without danger of re-fusing them. This may be also further prevented, if any doubt exists, by previously coating the solder in such joints with a solution of whiting in water or alcohol before attaching the facing.

Disadvantages. The features of this style of construction which are of a more or less pronounced disadvantage, in a general way, lie in a consideration of the essentials of time, strength and accuracy of adaptation.

Time. The detail being more circuitous, a greater length of time is necessarily consumed in the process. If better results by this method than by any other were possible, this should not necessarily be a consideration, but it becomes a matter of much concern when equally good results may be obtained by another method in *less* time.

Strength. The fact that a much thinner gauge of metal must be used to begin with, and that it must then be subjected to considerable stretching, is conspicuously a disadvantage, because of the extreme thinness and consequent weakness of the finished crown. While sufficient re-enforcement of the occlusal portion may be afterward made, the band, where equal and uniform *strength* is usually required, must remain inherently weak, or be stiffened at the expense either of the root or of the contour.

Adaptation. As a degree of accuracy *must* be insured in the process, the adaptation to the root of a primary or temporary band is necessary. This, however, in one particular is a disadvantage, because, irrespective of however accurate *it* may be, each subsequent reproduction of a given form is less accurate than the original, unless they may be stamped in indestructible and unyielding dies, which qualities are not possessed by fusible alloys, such as are used for the dies in this work.

Detail of Construction.

While there are many and varied methods of detail for the construction of seamless crowns, but *one* general line of procedure will be found to give results which are sufficiently reliable to insure an approach to the necessary degree of accuracy.

This constitutes taking a measurement of the root, after its preparation, and making and fitting a *primary* band, the exact shape and conformation of which is then subsequently reproduced in the finished crown.

Primary Band. The primary band may be made, preferably, of 32 gauge copper, cut to ordinary width, the exact length of the measurement, with straight edges, and soldered as usual. Or a seamless band may be made by selecting the drawing punch over which the circular measurement will fit most closely, and then drawing a blank down to this same size. By then punching out the top, a seamless band results, which approximates the size of the root as closely as the measurement fitted the punch. Those preferring the latter usually have a selection of these blanks already drawn to various sizes, which is an economy of time.

When the band has been made, it should be trimmed and fitted to the

root with the same degree of care and precision as though it were intended for permanent use. It should then be cut away upon the *buccal* and *lingual* surfaces until but a narrow rim remains, allowing the approximal surfaces to remain sufficiently wide to be closely adapted to the adjacent teeth. (Fig. 90.) By so shaping it, a perfect restoration of the contact points may be made, and increased opportunity is afforded for forming, shaping, modifying or exaggerating the buccal and lingual surfaces as may be desired.

Bite and Impression. When the fitting and trimming has been completed, the bite and impression should be taken. While this is often done at one and the same time, with wax or modeling compound, a *separate* bite in wax, and impression in *plaster* is preferable, and safer, because of the uncertainty of *replacing* the band in its *exact* and *proper* position in the former materials.

When these have been secured, and the band accurately replaced in position in the impression, the model should be obtained, the bite adjusted

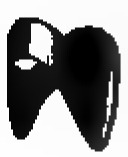


Fig. 90. Fig. 91. Fig. 92.

to it, and both securely mounted upon the articulator. After separating, the surfaces of the adjacent and occluding teeth should be varnished and the band and space filled with thin, well-mixed plaster, and the articulator firmly closed.

This portion of the procedure and the subsequent carving and shaping of the plaster is almost identical with the detail previously outlined in carving cusps, and all of the necessary artistic work must. of course, be done at this stage, because the permanent crown will be a close reproduction of this model.

The only difference in the detail is that the form and alignment of buccal and lingual surfaces is obtained by shaping the plaster, instead of contouring the wider band, and that it should be done *without* detaching the band from the model, and also that the plaster should be left flush, even and continuous with the band, instead of being trimmed to expose its edge as for a swaged cusp.

Preparing Models. When the necessary carving has been completed, the model should be detached from the articulator, and trimmed down until only enough remains to form a base for the crown, as indicated in Fig. 91.

This plaster base is then trimmed, so as to be favorable for, and facilitate handling during the process of securing the die, and to give

Fig. 93.
(Half Size)

adequate depth or body to the latter. The plaster base immediately adjacent to the *cervical* portion of the band should be cut away sufficiently to expose the full thickness of the edge, which thus stands out in the die and indicates the outline, after swaging, to which the finished crown should be trimmed. (Fig. 92.)

Casting Flasks. Various designs of casting flasks have been devised for the purpose of serving as a matrix in securing the dies with fusible alloy. Much similarity of principle exists between them all, and the one which is a part of the

A *Fig. 94.* B

Seamless Crown Outfit, manufactured by the Consolidated Dental Manufacturing Company (Fig. 93), is simple and conveniently adequate for such purposes; though those designed by Dr. W. H. Trueman (Fig. 94a) (which must be held in a vise while swaging), and the Berry Dental Manufacturing Company (Fig. 94b), will be found to favorably meet the requirements.

Dies.

In securing the die, the plaster model containing the crown should be *thoroughly dried* to prevent any bubbling of the metal, dusted with lycopodium, and then placed on a smooth level surface of steel or mouldine, so as to rest firmly and sustain a perpendicular position and the casting flask placed over and around it.

A piece of thin cardboard should be adjusted to the grooves in each side of the flask, and trimmed to *follow the outline* of the model (Fig. 95). These are intended to facilitate the subsequent separation of the die into two lateral halves, but should not come in contact with the model at any point.

The flask should then be filled with fusible alloy, poured when in the *plastic* state, in order to insure a smooth, well-defined casting, and to facilitate the separation of the crown from it.

Another method is to first fill the flask with the molten alloy, after adjusting the cardboard, and then firmly force the model into the center of the metal just before the process of crystallization takes place, holding it in position until it has thoroughly hardened. If done just at the right moment, this method is productive of good results, but the procedure is somewhat more uncertain than the former.

After chilling the metal with cold water, it should be removed from the flask and the cardboard detached. By inserting a chisel into one of the grooves thus formed, and striking it a moderate blow, the die may be easily separated into two parts. (Fig. 96.) The model is now removed from the die, and the parts may be readjusted to proper relation, and replaced in the flask, which possesses a guiding notch to insure proper read-

justment, and which holds them securely together during the process of swaging the crown.

Forming Blanks. The seamless blank, or cartridge, which is to be conformed to the desired outline of the permanent crown, by swaging, should now be formed.

For this purposes all of the "Systems" or "Outfits" contain or include

Fig. 96.

a steel plate with perforations, the diameters of which range consecutively from the largest to the smallest useful sizes, with a set of steel punches correspondingly graded.

A disk of 22 karat gold, not thicker than 30, or thinner than 32 gauge, should be procured. These are prepared by the supply houses in various sizes. The two sizes most convenient for molars and bicuspids are illus-

Fig. 97.

trated in Fig. 97 and may be symmetrically cut from plate by using an accompanying copper disk, or the end of a drawing punch as a guide.

These disks are formed into the blank by driving them through the holes in the plate with the drawing punches, beginning with the largest size and passing through *each* consecutive perforation until the blank is reduced to a size which will admit of its being gently forced into the die.

If a seamless *primary band* has been used, the size of the drawing punch last used in its formation will, of course, indicate the size of the blank required for the crown, and the size or number should be designated or remembered.

The gold should be *annealed often* during the process to prevent tearing, and slightly oiling the end of the punches and the interior of the perforations will be found advantageous in facilitating the drawing and preventing the blank from sticking to the former.

The *drawing press* designed for this purpose by Dr. W. M. Sharp may be found useful. It can be securely fastened to the bench and the blank is formed by means of a screwpress instead of driving, which re-

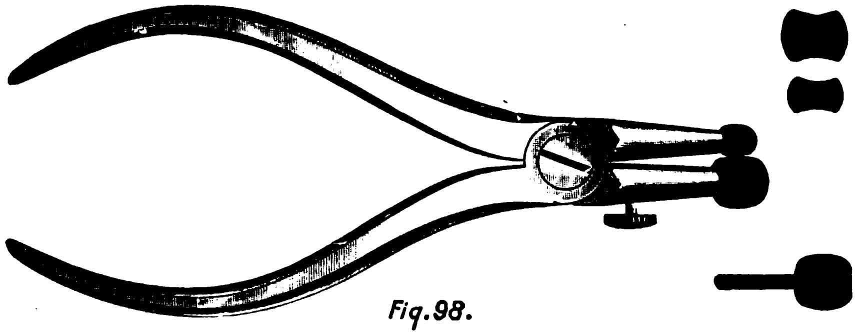


Fig. 98.

sults in its being drawn more evenly and uniformly than by intermittent blows.

Swaging. When the blank has been formed to the desired size, it should be cleaned in the acid bath, and then annealed. The surface of the die should be oiled and the blank *gently* forced well down into place with a blunt piece of soft wood of suitable size, and a small hammer.

Any excessive surplus of band may be previously trimmed away to facilitate swaging, but care should be exercised not to trim too much.

The interior of the blank should be filled with a substance which will spread readily and evenly when pressure is applied, but which may be *easily removed* at any time during the process.

Oiled birdshot, cornmeal, pumice stone, small cubes of modeling compound, base-plate gutta percha cut into small pieces, pledgets of moistened cotton, or cotton previously saturated with melted wax, stiff putty mixed with soapstone and tin foil rolled into small globules are used.

The swaging is then accomplished by driving a blunt piece of wood, or the end of a drawing punch a few sizes smaller, into the blank thus

filled. If necessary, the gold may be removed and annealed several times, though once after starting and *during* the process is all that is usually required.

Adapting and Re-enforcing. When the swaging has been completed, the surplus should be trimmed away to closely follow the cervical outline indicated in the band, and the crown *slightly* heated and subjected to the acid bath, when it may be re-enforced with a high karat of solder or a lower karat of plate gold, *rolled thin*, and finished.

If the finished crown should be too large, it may be reduced with pliers before re-enforcing, or if *much* too large as a result of compressing the walls of the die during the process of swaging, it may be first cut in two lateral halves, left in the die, and another crown swaged inside of it; or if too small, which is rarely the case, it may be stretched sufficiently with pliers. Where some expanding or compressing of the bulbous portion may be indicated in order to improve the contact with adjacent teeth, the rotary point contouring pliers designed by Dr. C. W. Miller will be found useful (Fig. 98).

While many of the various "systems" provide means for securing the *model* from a selection of typical forms of approximate sizes, from which the dies are made; and for securing the outline of the occlusal surface by subsequently swaging in a typical die-plate, or other similar manner, the possible results obtained from such methods do not merit consideration because of being but little, if any, more accurate than ordinary *ready-made* crowns.

Reverse Process.

In the preceding process it will be noted that in the detail of swaging, the blank is conformed to the outline of a *mould* or *die* of the original model, by *expanding* or stretching it. This is termed the *"inside-out"* method, and, while it is perhaps most generally used, the extreme thinness of the finished crown, augmented by the necessity of beginning with so thin a gauge, very consistently occasions the objectionable features already intimated in this connection.

As a means of overcoming such objections, and obtaining increased thickness and strength, the *reverse* or *"outside-in"* process of swaging has been devised.

In this method the blank is conformed by being *compressed* over a metal reproduction of the original model, instead of being *expanded* to meet the walls of a mould *of it.*

Advantages. While the process of swaging is perhaps more difficult to accomplish, the results are advantageous in being productive of a *heavier* and more *uniform* thickness of gold in the finished crown, and of greatly diminishing, if not entirely overcoming, the probability of tearing it.

Disadvantages. The result obtained by swaging the gold over the outside dimensions of a metal reproduction of the original and desired form, would seem to be objectionable in that the crown so conformed must be somewhat larger than the model. This, together with the tendency of the gold to overlap and knuckle here and there, during the swaging, are logical disadvantages, unless means are observed for overcoming them.

While the overlapping and knuckling may be easily avoided by careful manipulation of the gold during the process, the difference in size occasioned by the thickness of gold can be overcome *only* by using *force*

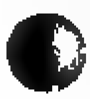


Fig 99

Fig 100

enough in swaging to so compress the die by the impact as to compensate for this thickness, or, by *removing* the primary band just previous to reproducing the metal model.

In view of the characteristics of the lower melting fusible alloys which are necessarily used, and of the thinness of the gold after being drawn down to the required size blank, it is possible that fairly accurate results may be obtained by depending upon the compression of the metal model from the force and impact of swaging; yet as this is more or less uncertain, the removal of the band is the preferable procedure and will afford the most positive and accurate results.

Procedure. As the *variation* between this and the preceding method pertains only to the manner of securing the dies, and to the process of swaging, the procedure up to the point of obtaining the model is identical with that already outlined.

Original Model. When the crown has been removed from the articulator, and its plaster base trimmed to the required form as previously indicated in Fig. 92, it should then be *reproduced* in fusible alloy, instead of obtaining metal dies of it in the form of a mould.

If the band is to be removed from the model, the plaster base should be trimmed away sufficiently deep so as to leave a distinct cervical outline to guide in trimming the crown after swaging. The removal of the band may be easily accomplished by cutting through it at the narrowest and most convenient point, with a fine saw or file, after which the entire plaster outline should be nicely smoothed down, and then varnished.

Mould. The mould is obtained in the same manner formerly pursued in securing the dies, *excepting* that it is made of *plaster* instead of metal. The varnished model should be adjusted to the casting flask, or similar device, with pieces of cardboard *in situ*, Fig. 95, and thin plaster then poured upon it. After crystallization this may be broken open, the model removed, and the parts replaced and adjusted to the flask.

Swaging Model. When the plaster has become sufficiently dry, this should be filled with fusible alloy which melts at, or below, the temperature of boiling water. The metal model thus resulting, Fig. 99, is identical with the original model, and over this the blank of gold is conformed by various processes of swaging.

Fig 101

Blanks. After drawing the blank to a size which will fit snugly over the swaging model, or securing the same from the supply houses in ready-made form, it should be first thoroughly annealed, as any subsequent annealing is prevented after the swaging has been started, because of the necessity for the destruction of the swaging model, by melting it, to admit of the removal of the blank.

Swaging. In conforming the blank to the outlines of the swaging model, considerable care must be exercised to prevent knuckling and overlapping of gold by any method employed. This can only be accomplished by frequently removing the crown and working out such places with a small riveting hammer, Fig. 100.

Methods.

While several systems and devices have been designed for the purpose of swaging crowns by this process, the cylinder and plunger are the essential features of the most useful ones, and even hydraulic pressure may be very serviceably employed.

Ash's crown swaging device can be made to answer the purpose by boring out the end of the plunger until it presents the form of a cone equal in depth to that of the average crown, and a similar apparatus especially designed to meet such requirements constitutes a portion of the seamless crown outfit manufactured by Mr. J. W. Place, of New York City. The *cone shape plunger* is necessary in order to distribute the impact evenly over the entire surface of the crown.

Fig 102

In the use of such devices the blank should first be fitted over the swaging model and gradually worked down to place with the riveting hammer. This should be placed in the center of the cylinder and oiled bird-shot or, preferably, stiff putty freely mixed with lycopodium or soapstone, then packed closely around and over it until entirely submerged. The plunger should now be inserted and gradually driven to place, removing the crown frequently and working out the overlaps, until the swaging is completed.

Scott's Method.

The apparatus designed by Dr. W. P. Scott, of Chicago, which consists of an inverted cone shaped cylinder, and straight flat-surface plunger, with other necessary accoutrements, is among the most complete, simple and modern inventions for this work, though it is similar to, and used much in same manner as the Berry and Adamson outfits.

In the use of this system the blank is fitted to the swaging model as indicated, and the occlusal surface first swaged by driving the same into a surface of lead. After this portion of the crown is adequately swaged, it is then placed in a matrix afforded between the two surfaces of lead which are formed in a mould accompanying the outfit, and the

whole then dropped into the cylinder. The base and top of the latter are adjusted, and the plunger inserted, (Fig. 101,) which upon being driven deeper into the cylinder so compresses the lead matrix, and the gold blank, as to closely conform it to the outlines of the swaging model, with a minimum tendency to tear or overlap, and with a maximum and uniform increase in the thickness of the gold. The lead matrix before and after swaging, together with the crown in position in the latter, are illustrated in Fig. 102.

Finishing.

When the swaging has been adequately accomplished by the method selected, very little finishing is usually required. The crown should be polished before detaching it from the metal model, after which the latter should be melted by placing in *boiling water*, and any adhering or remaining particles removed by the acid bath. The surplus gold at the cervical portion should then be carefully trimmed away to follow the outline indicated, when the necessary reinforcement and final polishing may be given.

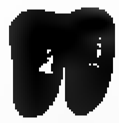


Fig. 104.

Fig. 103.

Application to Separated Molar Roots.

The presentation of cases where molar roots have become separated at the bifurcation as the result of extensive disintegration of the crown, and with each individual root remaining *firm* in its attachment, is not an infrequent or unusual occurrence.

In such instances the application of a crown will not only often restore the roots to the former usefulness and supply the serviceability of the original tooth for many years, but will also frequently preclude the *impaired occlusion* of the adjacent teeth which their natural gravitation or tipping, as the result of the loss of such roots, would occasion.

This latter phase places a degree of importance upon the permanent retention of these roots, which, particularly in early life, and especially on *first* molars, makes such a procedure of inestimable value, and causes it to be almost universally indicated wherever such a condition is found in otherwise unbroken or well-filled arches, with the roots remaining reasonably firm.

Procedure. In the treatment of these cases the individual roots should be carefully prepared by observing the therapeutic and mechanical requirements, and each then built up *separately* with amalgam (anchored with a post, or by other mechanical retention) until they afford favorable shape for the permanent attachment of a band. (Fig. 103.)

Bands. Separate bands should be fitted to each, their *occlusal* ends trimmed to allow for the cusp, and contoured to approximate each other, and restore contact with adjacent teeth.

Fig. 105.

The usual bite in wax and impression in plaster should be secured, and the case finally mounted upon the articulator. After separating, and detaching the bands from the model in such manner as to preserve their outline and admit of accurate replacement, they should be readjusted to the model and united securely together with hard wax; then they may be removed and the *cervical* one-half imbedded in investment material. Their relation may now be permanently sustained by filling in between

Fig. 106.

them with 22 karat solder, which union, involving the occlusal ends only, will leave a free, clean interproximal space. (Fig. 104.)

Cusps. The united bands may now be replaced upon the model and the cusps formed in the usual manner, as though for the single band of an ordinary crown. In attaching them, however, care must be exercised to prevent re-fusing the solder with which the bands were previously united, and thus chang-

ing or destroying the relation between them. The use of a lower grade solder will ordinarily preclude this, but to further facilitate it the cusps should be *filled* with solder after obtaining their proper adaptation, and previous to attaching them to the bands. Very little danger will then exist, and *any* may be entirely overcome by the use of a solution of whiting and alcohol, which precaution it is well to observe.

Application to Individual Roots.

Where but a single root remains or possesses sufficient strength, and particularly in the lower jaw, it may often be retained and made serviceable for a number of years by the application of a crown. Also, in instances where such a root may be unusually strong, and the space formerly occupied by the normal tooth has become lessened or partially closed as a result of the loss of the other root and the gravitation of the adjacent teeth, it is often practical to extend the occlusal portion of the crown until it rests against the adjacent tooth, and thus affords a continuous masticating surface. (Fig. 105.) The contact point between such a crown and the natural tooth, however, should be *only* sufficient to prevent tipping of the root from the stress of mastication, and for prophylactic reasons should rest close to the occlusal surface and be smooth and well rounded.

Cantilever Bridges.

A *small* intervening space between two artificial crowns may be bridged over until an unbroken masticating surface presents, by applying these same principles, as was originally suggested by Dr. J. N. Farrar. (Fig. 106.) Such a procedure would be most practical, however, in cases where a *very small* space existed, as one sufficiently large to accommodate a *dummy* could usually be best filled by constructing an assembled bridge.

Application of Amalgam.

Amalgam is sometimes employed in the restoration of badly broken down molar roots by crowning, and, while good results in the line of expeditious operations combined with a moderate degree of preservation and permanency are probably possible, any method possessing only the advantages of *time* and cost of production, and requiring less skill and effort than a manifestly better and more *artistic* one, should very naturally occupy the limited sphere of application and usefulness accorded to this.

In conditions and environments, however, which seem to indicate the application of such methods, it is possible to obtain fairly good results in the restoration of the crowns of second and third molars, where the occlusion is very *close,* by either of the following procedures:

With Band. Where a permanent band may seem indicated as a means of supporting the remaining walls of the root, and to aid in the retention of the amalgam, it should be made of gold, carefully fitted and adapted, and then polished and cemented to place.

Provisions should then be made for securely retaining the amalgam. This may be accomplished either by means of a post, cemented into one of the canals, or by cutting a mechanically retaining cavity if sufficient tooth structure remains.

Very plastic amalgam should then be packed thoroughly to place, and built up to the desired cusp formation, until a favorable occlusion is obtained.

After crystallization, and preferably at a subsequent sitting, the amalgam cusps should be well finished and polished; and, while the gold band will have assumed the same color by the superficial absorption of mercury, its original color may be brought back by *polishing,* if desired.

Without Band. If a permanent band is not desired, or seemingly unnecessary, the entire crown may be made with the amalgam. In this procedure a *temporary* band of thin German silver, 32 to 34 gauge, should be made and adapted to the root, as indicated. This is used only as a matrix for aid in adapting and contouring the amalgam, and may be easily removed from the latter, after its crystallization, by cutting, after which the amalgam crown may be finished and polished. The easy removal of the band may be further facilitated by coating its inner surface with vaseline or oil before inserting the amalgam, which will prevent superficial amalgamation with it.

Where extensive destruction mav preclude sufficiently adequate retention for the amalgam, it may be *first* tightly packed to the surface of the tooth and matrix, and around the projecting end of a dowel temporarily adjusted to the canal if the use of the same seems indicated, *without* any provisions for its retention. After crystallization both may be removed, the band separated, and the crown then finished and polished, and finally mounted with cement, after serrating or roughening the surfaces of crown and root. Such operations, however, are of doubtful permanency as compared with those wherein a permanent band is employed.

Application to the Anterior Teeth.

While it is difficult to conceive of a practice more flagrantly inartistic than the application of gold crowns to anterior teeth or roots, as has been previously observed, they are, nevertheless, occasionally employed.

In view of the opportunities for more artistic endeavors, and the increasing appreciation of and demand for the same, this class of gold crown is now the exceptional expedient rather than the common practice, and would doubtless soon become entirely obsolete were it not for a *innited* class of cases in which the requirements and environments seem to justify such a procedure.

Their application in any event, including even these exceptional conditions, should be made with an honesty of purpose, and a sense of professional duty, paramount to a mere catering to the perverted, unrefined vanity of the vainglorious.

Indications.

The class of cases in which their application is practicable and warrantable is confined to the mouths of men past middle age, where they are partially or entirely hidden by the beard. In such instances the use of gold crowns may be indicated in *two* general classes of cases:

First, where, from a more or less powerful masticating action, and by

Fig. 107.

years of constant and continued attrition, the remaining teeth have become so worn down as to require restoration with an absolutely indestructible material. *Second,* in crowning the *cuspid* teeth, when they are to serve as abutments for bridgework, and where it is desirable, and perhaps necessary from a mechanical standpoint, to allow as much as possible of the natural crown to remain in order to secure the additional strength thus imparted to the attachment between crown and root; and where the practical invisibility of the work may not require any special effort toward securing the more artistic effects afforded by other means.

The first class of cases are not uncommon or infrequent, and usually present a more or less perplexing problem. If an adequate number of the posterior teeth remain, and occlude with teeth in the opposing jaw, a more artistic result may often be obtained by crowning the posterior teeth in such a manner as to *open the bite* sufficiently to accommodate crowns having porcelain facings on the anterior teeth, with reasonable

assurances of permanency and usefulness. But in the event of the loss or absence of properly occluding posterior teeth, all, or the greater portion, of the work of mastication may be thrown upon the remaining anterior teeth, and thus preclude the use of porcelain and occasion the necessity for gold, unless the posterior teeth be first supplied by artificial dentures.

Fig. 107 illustrates a case where the bite was opened by placing crowns upon the posterior teeth, with cusps sufficiently thick to withstand the work of mastication, and which thus admitted the application of porcelain-faced crowns to the anterior teeth. Fig. 108 illustrates a case where the absence of the posterior teeth indicated the use of gold on the remaining anterior teeth, and where the crowns were further fortified against the stress of mastication by tipping each with 26 gauge clasp-metal. The

Fig. 108.

use of the clasp-metal is especially indicated where both upper and lower teeth are crowned and the crowns occlude with one another.

Procedure.

In the application of these crowns, several methods are employed. The requirements of root preparation, as have been outlined in general, include securing the greatest diameter at the cervix by reducing the coronal proportions, and further sacrificing the approximal, labial, lingual and incisal surfaces until the remaining structure will admit of properly shaping and contouring the crown, when the measurement should be taken as heretofore indicated. A band of 28 or 29 gauge, 22 karat gold should then be cut the exact length of the straightened measurement wire, and somewhat *wider* than the required length of the crown.

Adaptation to the Mouth.

As the correct adaptation can be most accurately obtained by fitting directly upon the root, and but little time is thus consumed, the use of models is unnecessary.

The band should be soldered, trimmed to meet the gum line evenly

(Fig. 109, a.), and then forced to place upon the root. When the cervical adaptation has been completed, the *lingual* portion of the band should be cut away, following the original curvature and outline of the tooth. (Fig. 109, b.) The labial surface may now be contoured with the pliers until it assumes proper shape and alignment, and restores contact with adjacent teeth, in which the artistic results possible are, of course, in proportion to the degree of skill displayed.

The incisal end should now be trimmed to the proper length and shape, with an allowance for the thickness of the lingual plate to be subsequently attached, and of the clasp-metal also, should its use be desirable or necessary.

A piece of gold, somewhat larger than necessary, 28 to 30 gauge, 22 karat, should be adapted to the lingual portion of the band, held in contact with pliers or wire, and soldered from the inside. (Fig. 109, c.)

Fig. 109.

Adequate re-enforcement of the incisal end should be obtained by filling in sufficiently with solder, or by attaching a piece of clasp-metal, previously cut to the exact size and shape, along the edge.

The surplus should be cut away, and the crown subjected to the acid bath; then finished and polished.

Adaptation to Models. When it may become necessary, or seem desirable, to construct the crown upon models, thus confining the work to the laboratory, a *narrow* primary band of copper or German silver, 32 gauge, should be fitted to the root, and an impression, including the adjacent teeth, then taken in plaster.

When this has been secured, the band should be adjusted accurately to place, and the model obtained with fusible alloy, which is preferable to plaster, being more indestructible.

With a sharp chisel or bur the *outside* surface of the band on the model should be first freely exposed, when it may be cut in two and detached. This will leave the adjacent teeth and the correct cervical outline of the root definitely exposed in the model, and the crown can then be constructed upon it in the manner indicated, with reasonable accuracy.

Carving and Swaging. Those who may experience some difficulty in shaping and contouring the labial surface with pliers in an artistic manner, may be able to obtain better results by carving and swaging both labial and lingual surfaces, though this method seems unnecessarily circuitous.

To accomplish this the primary band should be fitted, the impression taken, and a model secured in *plaster*. The band should be carefully detached from the model and the latter varnished. With the band again adjusted to position, the intended crown may be formed with plaster, which, after hardening, may be carved to the desired form. By the use of mouldine *separate dies* may now be secured of the *labial and lingual* surfaces, with the line of junction at the center of the approximal and incisal surfaces. (Fig. 110, a.)

Each surface should be swaged separately; the surplus trimmed away; the edges passed over a flat smooth file until they approximate

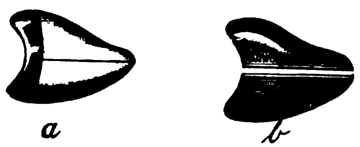


Fig. 110.

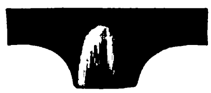


Fig. 111.

evenly (Fig. 110, b.), and the two finally soldered, with sufficient incisal re-enforcement.

In this procedure the degree of accuracy obtained in the finished crown will depend much upon first drawing or designating a definite line between the two lateral halves of the plaster crown; then securing an imprint of each surface in the mouldine, having a well defined edge evenly approximating this line, and finally trimming away the surplus gold, after swaging, with care and precision before uniting the two with solder.

The accuracy and indestructibility of the metal model, however, supplemented by the definite reproduction of the diameter and cervical outline of the root, which is afforded by the primary band, aids materially in securing the desired result.

Die-Plate Methods. The various die-plate systems supplying a selection of dies of the labial and lingual surfaces may often be employed to good advantage, with perhaps increased artistic effect, and a reasonable degree of accuracy, though they give a more typical reproduction of tooth-form than is usually necessary or required, except possibly for the cuspid teeth, as considered in the *second* class of indications.

Lowry and Millett Systems.

The dies for this purpose contained in the Lowry and Millett systems include only the *labial* surfaces, and may be used in accordance with their application as formerly outlined. In their use the measurement is taken and a band cut the proper length and width. The die is selected which approximates the individual requirements of the case, and the immediate center of the band is then conformed by swaging; after which it is trimmed, as indicated in Fig. 111, made in circular form and soldered. It is now fitted and adapted to the root, trimmed to assume the proper lingual curvature, and to admit of the attachment of the lingual plate, as previously shown in Fig. 109.

Hollingsworth and Baird Systems.

The Hollingsworth and Baird systems include separate dies of *both the labial and lingual* surfaces mounted on a single base, and may be used in similar manner, in accordance with their application, as previously outlined.

When the die which most closely approaches the requirements for side, size and form has been selected, the gold should be swaged, and both sides of the crown then trimmed until properly approximated. They should then be wired together, fluxed, and soldered from the inside. (Fig. 112.) While it may now be possible to so trim and shape the cervical end as to secure a fairly good adaptation to the root, a more accurate result may be obtained by adapting a narrow band of gold to the root and then fitting the crown *over* it, and subsequently attaching them with solder, when the incisal end may be adequately re-enforced and the crown finished and polished.

Fig. 112.

Seamless Method.

The application of the seamless method to the restoration of anterior *roots* is *identical* in detail to the procedure previously indicated in the construction of bicuspid and molar crowns. As the lingual outline of the adjacent teeth, however, will often serve as a guide, the taking of a "bite" becomes necessary only when the opposing teeth may be irregular, or where an incisal or "end to end" occlusion is required.

The primary band should be made and fitted in the manner outlined, and the impression secured in plaster. When the model has been obtained, the crown should be formed and carved, and the dies made in accordance with, and the swaging accomplished by, the process selected.

Seamless crowns are also especially useful for bicuspids where porcelain facings are to be attached.

Reproductions. In applying this method to the construction of cuspid crowns where the entire natural crown remains, accurate *reproductions* of the tooth may be quite easily made. To accomplish this, the natural crown must first be trimmed sufficiently on the approximal sides to admit of an accurate adjustment of a band to the cervix, and, if necessary, upon the incisal, labial and lingual surfaces, to admit of securing the proper length, alignment and occlusion. A *narrow* primary band should then be fitted to the neck of the tooth, and the impression and subsequently the model secured in plaster. The plaster tooth should now be cut from the model in the manner indicated in Fig. 91, and the dies or swaging model secured as the selection of processes may require. When the swaging has been completed, the crown will be a close reproduction of the tooth and will fit it accurately. Sufficient incisal re-enforcement to prevent wearing through, however, must always be made, even at the expense of grinding the natural crown, if necessary.

This procedure is sometimes employed without using the primary band, but is, of course, *less* accurate, as the band indicates the proper relation to the root under and within the free margin of the gum, which otherwise can only be *approximated* by trimming the model at this point.

Dowels. In those cases where the natural crowns are so badly worn or broken down as to afford inadequate attachment for the crown, the use of a dowel may become necessary as a means of supplementing the telescope attachment, and thus offering increased integrity. Their application may be made by first fitting them to the canal, and then allowing a projecting end to extend into the crown as far as its incisal edge will admit. After thus ascertaining the proper length, the dowel should be previously cemented to place in the root, and the crown subsequently attached.

Application to Deciduous Teeth.

In some fortunately rare and exceptional instances, where the extremely poor character of the deciduous teeth precludes their temporary preservation by other means, and demands the employment of some heroic, or, perhaps, radical procedure to prevent their premature loss, the application of gold crowns may be indicated as the most simple, expedient and available means of preserving them until the time for the eruption of their permanent successors.

In such cases little or no preparation would of course be possible, or necessary, and good results may often be accomplished by covering the little crowns of such teeth with caps made of pure gold.

In the procedure a wire measurement of the cervical circumference should be taken, and then an impression in *wax,* from which a plaster model may be secured, which will afford sufficient accuracy for the purpose.

Pure gold about 34 gauge should be then cut the length of the measurement, made in circular form and soldered, and then fitted and shaped as accurately as possible on the model.

It should then be finally soldered, with but little reinforcement, and finished and polished.

The tooth should then be thoroughly disinfected, and the crown mounted with cement, and carefully burnished to a close adaptation with the neck of the tooth.

By this means this class of teeth may be saved until the proper time for their loss with the utmost expedience, and without unduly taxing the patients of such tender years.

Ready-Made Forms.

As a woful acknowledgment and conclusive evidence of the lack of skill possessed by some, and of the ever-ready willingness of the supply-houses and commercial dentists to cater to and supply the *demand,* a large variety of ready-made seamless crowns, in gold and aluminum, are procurable *ad libitum.*

They are made of moderately typical form, in a gradation of sizes, of 22 karat, 30 gauge gold, and about 26 or 28 gauge aluminum, and in their use a measurement of the root is taken and a crown selected which approximates the same diameter. The cervix is then trimmed until a closure of the occluding teeth, with it in position, is possible, when it is fitted to the root with pliers, and, if of gold, re-enforced with solder and mounted.

The most accurate method of fitting a ready-made gold crown to a root is to cut a slit in each approximal surface, lap the edges, place the crown on the natural root and contract its cervical circumference by encircling the crown with annealed German-silver or copper wire and twisting the wire till the band is in good contact with the root. Adaptation is further perfected by burnishing, after which the slits are united with solder.

That such crowns may be correctly adapted to all the requirements of all environments is doubtless a claim which no conscientious skilful operator would make, because, while their individual formation is fairly typical of the natural teeth, it is difficult to conceive of securing a ready-made form which can be adapted to the requirements of cervical adaptation, approximal restoration, occlusion and alignment, all combined.

Indeed, these requirements are often difficult to obtain in a crown

which is made for the individual case, and at the expense of every degree of energy, skill and handicraft possessed by, and at the command of, the operator.

The progress of dentistry, and the artistic possibilities pertaining to it, have only been achieved by the development of a superior skill which cannot be acquired by the adoption of such indifferent methods.

Removing and Repairing.

As a result of pathological disturbances arising beneath them, or for the purpose of substitution or replacement, it not infrequently becomes necessary to remove a gold crown from its attachment to the root.

In the presence of conditions demanding therapeutic treatment, it is sometimes possible to cut through the occlusal surface of the crown on a line with the pulp chamber, with a sharp, spear-point drill or round bur, and then enlarge the opening until adequate access to the canals is secured. The necessary treatment may then be made through this opening, upon the completion of which the pulp chamber and crown may be filled with cement, and a gold filling, anchored in the cement, subsequently inserted until the opening is imperviously closed.

While such a procedure may be productive of successful results in some instances, particularly in bicuspids or single-rooted teeth, it should not be regarded as a *safe* one in most cases, because the presence of the crown only adds to the difficulties to be encountered in an operation which is usually trying enough under the most favorable circumstances, and with every advantage of access and light.

For this reason the removal of the crown is almost invariably indicated as a means of affording greater convenience and increased opportunities for success, and may be easily accomplished in two ways.

Crown Slitting Forceps.

Where it is not necessary to preserve the continuity of the band for subsequent replacement of the crown, and in emergency cases where its immediate removal is indicated or demanded as a means of affording relief, the crown slitting forceps may be used to good advan-

tage. Those designed by the S. S. White and the Consolidated Dental Manufacturing Companies, the application of which latter is shown in Fig. 113, are especially useful in securing the easy and expeditious detachment of the crown from the root.

In their use the flat beak should rest firmly upon the crown, and the sharpened one caught just under the edge of the band, when a slight compression of the handles will quickly separate it. The band may then be pried away from the root with a smooth flat burnisher until a pointed instrument can be slipped in between cusp and root and the crown lifted off, which may also be often done with the forceps alone.

Preserving Continuity of Band.

When the same crown is to be replaced, it may be desirable to remove it without destroying the continuity and shape of the band, thus distorting its adaptation. This may be easily accomplished by drilling through it with a round bur at a *convenient* point, as close to the occlusal surface as the probable thickness of the cusp will admit (Fig.

Fig. 114.

114), and then burring out as much of the cement detween cusp and root as possible by a lateral movement of the bur. A stiff, blunt-pointed instrument, similar to an old hand-plugger, should now be inserted into the opening, until its end rests about on the center of the root, thus securing a leverage by the establishment of a fulcrum, when the crown may be lifted off with but little effort.

Repairing

While a crown removed with the slitting forceps may be easily repaired, as no material is destroyed, it is doubtful if the edges so cut can be again brought into proper relation and contact without requiring a readaptation to the root in case of replacement. Aside from this, the two procedures may be interchangeable and can be used as convenience and requirements may seem to indicate.

In either event, when repair is necessary, all remaining cement should be first removed with a bur, and the crown then thoroughly cleaned in acid, when the perforations may be filled with foil gold, and, together with other openings, then finally closed with 18 karat solder.

The Shell or Telescope Crown in Combination with Porcelain.

CHAPTER VIII.

Indications. Application to Anterior Teeth: Jacket Crowns; Malformed Teeth, Extensive Abrasion, Procedure; Band, Facing, Backing, Soldering. Application to Irregularities. Application of Facings to Bicuspid Crowns: Procedure; Preparing Crown for Reception of Porcelain, Adapting Facing, Adapting Backing, Soldering Backing, Soldering Facing. Variation of Method. Application of Saddle-back Teeth to Bicuspid and Molar Crowns: Procedure. Dowels.

The application of porcelain facings to crown construction, wherein the shell or telescope principle of attachment to root is employed, involves several varied methods and processes, many of which are often indicated in special classes of cases, and may be productive of practical and artistic results.

While the modern application of the ceramic art doubtless offers far greater opportunities for more æsthetic and hygienic achievements in this line of work, the essential requirements of *strength* as applied to the method of attachment to the root, as well as to the completed crown, are factors not infrequently contraindicating its use. These, together with the absence of facilities, or the lack of experience and skill, may often indicate the combination of gold and porcelain as a means of obtaining increased strength, and of securing, or more closely approaching, the desired artistic and æsthetic result.

Indications. The application of this style of crown construction is especially indicated in that class of cases where it seems desirable, or becomes necessary to utilize a portion of the remaining natural crown for the attachment of the artificial substitute, by telescoping it instead of sacrificing it to the gum line and employing a dowel; and where the presentation of porcelain is essential to the artistic requirements.

Those conditions in which these combined requirements are particularly applicable, and the preferable and most practical methods of subserving them, will be considered in their respective classification.

Application to Anterior Teeth.

The application of this style of crown to the six anterior teeth, upper or lower, is frequently indicated, but should be made only in the absence of a better method, and in accordance with the judgment and discretion of experience, because the practicability of the principles involved has been much abused by the indiscriminate and too extensive use of the design known as the jacket crown.

Jacket Crowns. The so-called jacket crown is often a most useful style of construction, but is particularly so in the restoration of malformed crowns of teeth, as previously indicated in Fig. 29, and in conditions of extensive abrasion. As the proportions of the remaining natural crown, however, are ordinarily retained at the expense of the *strength* of the artificial substitute, because of the limited amount of space, the requirements of occlusion and alignment must be, or be made, *favorable* to the reception of a crown possessing sufficient strength to withstand the stress. For this reason the use of gold in combination with porcelain facings usually affords greater strength than all-porcelain work.

Malformed Teeth. In the restoration of the crowns of malformed teeth the use of the jacket crown is particularly applicable because of the usual favorable shape and formation of the natural crown; and for the reason that it is often desirable to preserve the vitality of the pulp in such teeth, because of the probable unfavorable length and imperfect development of the root, which might often preclude securing adequate mechanical attachment of a dowel crown.

In such conditions the destruction of the natural crown would, of course, be of doubtful advantage, and sometimes even unwarrantable; and the preservation of the vitality of the pulp presents a favorable prognosis because usually so little mechanical preparation would become necessary that no great shock or irritation would be induced, and the dentine is not deprived of the protection of its coat of enamel.

Extensive Abrasion. This style of crown is also frequently indicated as a means of arresting the destructive influences of abrasion and restoring the natural crown in a useful and æsthetic manner. If the occlusion in such cases is, or may be made, favorable for, and the requirements indicate the use of, porcelain facings, the preservation of the remaining natural crown may afford the advantage of a more accurate and perfect reproduction of the occlusal surfaces, and at the same time adequate stability to the attachment of the crown.

The advisability of destroying the vitality of the pulp in these cases is much a matter of judgment, but is not always essentially a prophylactic

measure, because such conditions are not usually found in early life. Hence, as a result of the combined influences of age and continued attrition, the pulps have usually receded, and the canals are not infrequently found to be partially or entirely obliterated. The degree of sensitiveness manifested during the necessary mechanical preparation will serve as a guide, however, in indicating the requirements in this connection.

Procedure. The first procedure constitutes the preparation of the remaining natural crown until its periphery presents a favorable shape for the accurate adaptation of a band, and the *labial, lingual* and *incisal* surfaces are sufficiently reduced to afford accommodation for a facing, and admit of a favorable occlusion. (Fig. 115, a.)

Fig. 115.

Band. A band of about 30-gauge 22-karat gold should then be fitted to the root, passing just freely beneath the gum. After completing the adaptation of the cervical end, the *labial* portion should be cut away on a gradual slope, closely following this surface of the remaining crown, until the facing may be carried to the gum line. The lingual portion of the occlusal end should then be trimmed until it offers no interference to the occlusion, after which the interior of the band, in position on the root, should be filled even to its edge with wax, and the bite and impression secured.

Facing. When the model has been obtained and mounted upon the articulator, a facing of the thin neck variety of mould (Fig. 115, b.) should be selected and ground to place, with a slight allowance for the thickness of the backing.

Backing. Pure gold, 34 to 36-gauge, should be closely adapted to the entire lingual surface of the facing, so as to join or come in direct contact with the band along its labial and cervical edge when adjusted to position (Fig. 115, c.). When the backing has been properly burnished and trimmed, and anchored to the facing by bending the pins, the band should be detached from the model, then replaced in position and the proper relation between it and the facing sustained with adhesive wax. The joint between the band and

backing should also be filled with melted wax as a means of keeping it clean and facilitating the subsequent union of the two with solder.

Soldering. When invested, the wax should be removed and a small cap of 22-karat or pure gold closely fitted to the *interior* edge of the band. The case should now be fluxed, heated and soldered, with as much re-enforcement and contour as the occlusion will permit. (Fig. 115, d.)

In cases where a broad, flat contact surface for the opposing teeth may be required, successive layers of clasp metal may be attached with solder until a favorable occlusion is secured. In this event the incisal end of the thin pure gold backing must be also adequately re-enforced with solder, though a better method of backing for such cases will be subsequently considered.

It will be noted that the adaptation of the crown to the projecting conical end of the natural tooth is not close, but a closer conformation is usually unnecessary if the cervical edge fits, as the increased quantity of cement thus used in mounting adds materially to the strength of the attachment.

If, for any reason, a more perfect adaptation may seem indicated, or desirable, it may be easily secured by burnishing or swaging a cone of pure gold, 34 to 36 gauge, or platinum foil, 1-1000 in thickness, to the tooth in the mouth, after the band has been fitted and trimmed; then adjusting first the cone and then the band to position, removing them *in situ,* with their relation sustained with wax, and investing and soldering them, when the crown may be completed as indicated.

Such a procedure is seldom required or even warrantable, however, because so little cement could be used in mounting that a more or less weak attachment would necessarily result. While the simple telescoping cone is sometimes used without the band, the latter is essentially advantageous as a means of securing sufficient strength at the cervical end and adequate adaptation to the root beneath the gum.

When the crown has been finished and polished, the remaining natural tooth should be roughened or slightly serrated with a thin edge stone, or sharp bur, before mounting, as such a procedure offers a mechanical supplement to the adhesive properties of the cement, which affords increased strength in the attachment.

Application to Irregularities.

The jacket crown may also be found occasionally useful in the treatment of irregularities, where the character and position of the teeth, and the age of the patient, may not warrant the usual procedure for their correction.

The method advocated by Dr. George Evans is illustrated in Fig. 116, and consists of constructing a gold crown for the malposed tooth, and then attaching a facing to it by means of a heavy round wire, so adjusted as to carry the facing in its proper relation to the adjacent teeth, and to be free of the occlusion.

The more or less conspicuous appearance of the gold crown, even

Fig. 116.

though partially hidden by the facing, is an objectionable feature, however, and equally useful and more artistic results could be usually obtained by sacrificing the natural crown and adapting a dowel crown to support the facing in its proper position.

Application of Facings to Bicuspid Crowns.

As a means of eliminating the objectionable and conspicuous display of gold in crowning the bicuspids, the application of porcelain facings to gold crowns is frequently indicated, and, if skilfully executed, approaches the more artistic results achieved in the use of porcelain work, or dowel crowns.

While various methods are advocated and employed, a slight modification of the one suggested by Dr. Hollingsworth meets the requirements in the most practical, artistic and expeditious manner.

Procedure. In the procedure the gold crown should be first constructed by any of the various methods in which the swaged cusp is used, but the band and cusps should be soldered with 22-karat solder, and *no* re-enforcement of the cusp made at the time of uniting it to the band.

When thus completed, and roughly finished, the root should receive further and proper preparation for the accommodation of the porcelain facing This constitutes sacrificing the buccal surface on a gradual slope to the lingual, at an angle sufficient to admit of the presence of the facing when placed in position on the crown, as previously illustrated in Fig. 40.

Preparing Crown for Reception of Porcelain. The crown should now be adjusted to the root and the outline of the exposed area, to be occupied by the facing, marked in the gold with a sharp-pointed instrument, and subsequently cut out with a fine saw, as indicated in Fig. 117, a.

After filing the edge smooth and even, with the convex surface of a fine half-round gold file, a thin *cuspid* facing of proper size and color should be selected and ground to place.

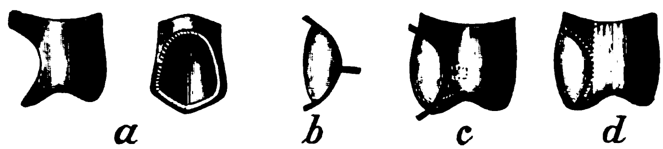


Fig. 117.

Adapting Facing. While the grinding may be done on models, when necessity or occasion requires, the most accurate results can be accomplished by filling the interior with wax, when in position on the root, and completing the adaptation in the mouth. In grinding to the necessary alignment, and approximation with the edge of band, care should be exercised to avoid sharp angles and any unnecessary weakening of the pins.

Adapting Backing. When the desired adaptation has been completed, a sufficient allowance for the thickness of the backing should be made by further grinding the facing or the band, or both; and the facing then backed up with pure gold, about 34 gauge. In the adaptation of the backing a small surplus should be allowed to project beyond the facing at all points (Fig. 117, b), and care must be exercised to avoid overlapping it, to accomplish which it may sometimes be necessary to cut out a small V-shaped piece at each occlusal angle.

Soldering Backing. The facing and backing should now be placed in position on the crown, and a sharp instrument passed around the buccal edge of the crown, marking the proper relation between it and the backing (Fig. 117, c), after which it should be detached, and the backing soldered to the crown from the *outside* with 20-karat solder, using enough to form a *smooth* joint, which may finish down *flush* with the porcelain when the surplus is removed;

and the necessary re-inforcement of the cusps should be made at this time.

The proper relation between the parts may be most easily and securely

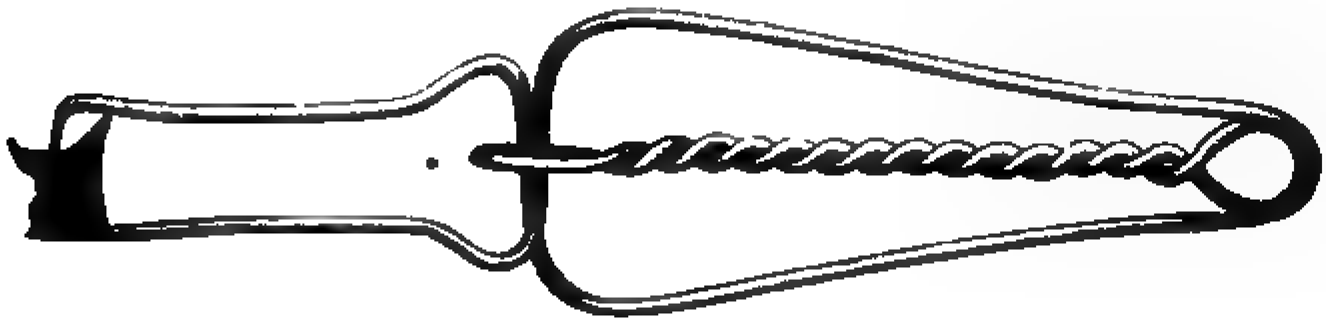


Fig. 118.

sustained while soldering by the use of pliers similar in design to those previously recommended for attaching cusps, or the ordinary nickel automatic soldering tweezers may be used by bending one end at right angles, as indicated in Fig. 118.

When the soldering has been completed, the facing should be adjusted to position and the surplus trimmed down until a *smooth* edge presents between crown and facing, being careful to *avoid any overhanging edges of metal upon porcelain.*

Soldering Facing.

While the permanent retention of the facing may be secured by bending the pins down against the backing, on the inside of the crown, greater strength will be obtained by soldering, on account of the extreme thinness of the backing. This may be quite easily accomplished by first bending the pins down close upon the backing, and then wrapping the crown with one thickness of asbestos paper, with the *occlusal* end folded together, and the whole held in place by wiring. The backing and pins should then be fluxed, preferably with liquid flux, and a sufficient quantity of 18-karat solder also fluxed, and placed in position. This should now be carried to the flame, with the *porcelain downward,* and *gradually* brought to the point of greatest heat (Fig. 119), when a small flame from the blow-pipe may be directed upon the facing until the solder fuses, which can be readily observed from the open cervical end.

Fig. 119.

While this or any other style of investment is not altogether necessary, if extreme care be exercised in subjecting the crown to the heat, the

use of asbestos paper possesses the advantage of absorbing but little, if any, heat, and of precluding the possibility of fracturing the facing, by distributing it evenly.

When the soldering has been completed, the crown should be treated to the acid bath, and then finally polished (Fig. 117, d), and mounted.

If an undue prominence of the root interferes with its proper adjustment, it may become necessary to sacrifice more from the buccal surface, but the lingual surface should always be allowed to remain as long as possible, in order to afford the greatest degree of strength to the attachment.

Variation of Method.

Another process or method productive of practically the same results, but entailing a different procedure, is employed by many. This constitutes first making the band, and fitting it to the root, and then cutting out the buccal surface to accommodate the facing as indicated in Fig. 120, a.

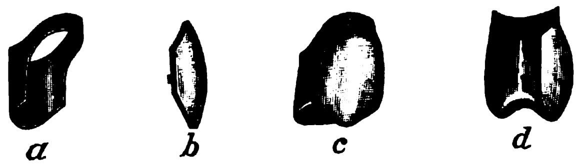


Fig. 120.

The usual bite and impression should now be taken and the models secured and mounted upon the articulator. A cuspid facing of suitable size and color is then ground to place until the proper alignment, and a perfect joint with the cervical and approximal edges of the band, are secured. After backing the facing with 30-gauge 22-karat gold, and bending the pins (Fig. 129, b), the band should be detached from the model, the facing placed in position upon it, and their relation sustained with a *minute quantity* of fluxed wax. Asbestos paper should now be wrapped around the parts and wired, as indicated, and the joint between the two filled with 20-karat solder (Fig. 120, c).

This portion of the crown should now be readjusted to the models, and the cusps formed to fit the band and facing, and meet the requirements of occlusion, after which they should be filled with 18-karat solder.

In attaching the cusps to the band and facing they should be first retained in proper relation by the use of a small quantity of fluxed wax. Asbestos paper should now be wrapped around the crown with the occlusal end knuckled in *close* to the cusps, and then wired securely to place

by twisting the wire very taut around the approximal, occlusal and cervical surfaces, to sustain the relation of the cusps, as well as having an additional piece of wire pass around the center of the crown to hold the paper together.

With the surplus ends of the wire projecting from the *cervical* end of the crown, it may be carried to the flame, *cusps downward,* and so held until the solder, already in the cusps, has re-fused and united with the band.

If insufficient solder has been placed in the cusps to accomplish union in such manner, more may be added at this time, and, as in the previously mentioned method, if any danger of re-fusing or unsoldering joints, already made, seems probable, the same can be overcome and prevented by first coating them with a solution of whiting in alcohol or water, or other similar means.

After soldering, the crown should be allowed to cool slowly and gradually, and then may be removed from the investment, finished and polished (Fig. 120, d).

While such crowns may be invested in ordinary investment material, the soldering can be accomplished with equal facility and accuracy, and much more easily, in this manner.

Application of Saddle-back Teeth to Bicuspid and Molar Crowns.

The application of the saddle-back tooth to the construction of bicuspid and molar crowns is sometimes practicable as a means of admitting of the shell or telescope principle of attachment, and of affording an artistic and æsthetic result, because of presenting an occlusal surface of porcelain.

The element of strength possessed by such a crown, however, depends much upon the extent of space, and the force of the masticating stress, in the individual case, as the *lingual cusps* are weak points, unless sufficient space exists so as to require but little, if any, grinding, and adequate opportunity is offered for protecting and supporting them.

Procedure.

In the procedure incident to the construction of such a crown, the band should be made and fitted in the same manner pursued for an all gold crown, and the bite and impression then taken.

The root should be afterward trimmed to accommodate the presence of the porcelain.

When the models are mounted upon the articulator, a saddle-back tooth (Fig. 121, A), the occlusal surface of which approximates the size and proportions of the band, should be selected. In no instance should the porcelain be much *smaller* than the diameter of the band, but in the

event of its being too large it may, of course, be ground to proper proportions.

The band should now be detached from the model and cut away with curved-pointed shears to admit of the proper adjustment of the porcelain (Fig. 121, b).

The porcelain should then be carefully ground until it meets the requirements of alignment and occlusion, comes in contact with the remaining cervical edge of the band, and fits into the *interior* of the lingual and occlusal portion.

It should now be backed up with pure gold, about 34 gauge, securely attached by bending the pins (Fig. 121, c), and then placed in position on the band, and the proper relation sustained with melted wax.

After filling the interior with soft wax to keep it clean, the crown should then be invested by submerging it in a slight covering of investment material, leaving only the wax exposed.

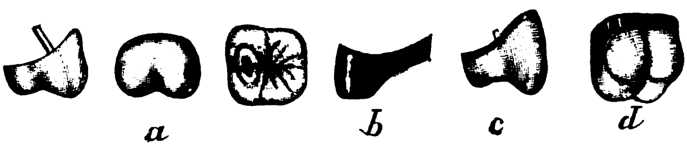


Fig. 121.

Upon removing the wax the interior of the crown will be exposed, when flux can be applied and sufficient solder placed over the pins and around the joint. The case should then be gradually heated to a red heat, when a small flame from the blow-pipe, directed *into* the crown, will quickly accomplish the soldering.

When removed from the investment and subjected to the acid bath, the band should be burnished up closely to the porcelain, and the crown finished and polished (Fig. 121, d).

Dowels. In the application of crowns constructed by these latter methods, the shortness of the root may sometimes indicate the use of a dowel as a means of supplementing the band and affording a stronger attachment to the root. When this is required, or seems desirable, it should be first fitted to the canal and a projecting end extended into the lingual portion of the crown as far as its proper adjustment will admit. The dowel should then be cemented to place in the root, and the crown separately and subsequently mounted.

The Band and Dowel Crown.

CHAPTER IX.

Indications. Requirements: Mechanical, Esthetic; Cervical Curvature, Alignment, Color and Harmony, Oil Colors, Manufacturers' Products. Dental Laboratories. Method of Construction: Procedure; Bands, Soldering, Fitting. Forming Cap. Dowels. Bite. Impression. Adaptation of Facing; Cervical End, Incisal or Occlusal End. Backing of Facing; Adaptation. Re-enforcement. Soldering, Finishing. Variation in Method. Use of Platinum. Investing. Soldering. Finishing. Application of Partial Bands: Comparative Advantages, Indications, Procedure. Application of Riveted Facings: Procedure, Riveting. Application of Detachable and Replaceable Facings: Advantages Claimed, Advantages Considered, Advantages Obtainable, Various Designs; Mason's Facing; Application. Roach's Facing; Application. Dwight's Facing; Application. Bryant's Method: Application; Box Method, Tube Method. Davis Crown. Application to Bicuspids and Molars: Indications; Bicuspids, Molars. Procedure; Re-enforced Cap, Use of Two Dowels, Bite and Impression. Use of Flatback Facing, Facing, Cusps, Adaptation, Approximal Restoration, Investing, Soldering. Use of Saddle-Back Teeth: Procedure. Use of Vulcanite Teeth. Application of Removable Crowns. Application to Irregularities: Indications; Malposition, Construction, Extension for Support of Facing, Hygienic Considerations. Diminution of Normal Space; Separation of Teeth; Application of the Intradental Band; William's Method, Application; Cigrand's Method, Application. Repairing: Replacement of Facings; Usual Method, Procedure. Brewer's Method; Application. Underwood's and Mitchell's Method; Application. Dwight's Method; Application. Bryant's Method; Application. Replacing Bicuspid and Molar Facings. Replacement of Facing and Backing; Procedure. Removing; Use of Excising Forceps, Separating Cap and Dowel; Accuracy in Model Making, Improved Articulators.

The usefulness and seviceability of the band and dowel crown in the various phases of its present application and construction account for its extensive employment, and warrant giving special emphasis to the detail of the respective methods advocated.

While the primitive application of a band as applied particularly to the construction of anterior crowns, and combined with a dowel and porcelain tooth or facing, was probably first suggested by Dr. C. M. Richmond, the present methods of construction, and the facil-

ities for accomplishing the requirements, have so modified the original design as to cause its complete abandonment, and the adoption of a procedure more practical, artistic and expeditious.

As there have been innumerable processes proposed, only the more practicable of those now in use will receive attention.

Indications.

Because of the necessary use of porcelain for esthetic reasons, and of the additional strength and stability in the attachment afforded by the presence of a band, together with the hermetical sealing of the root and the safeguard against fracture, this style of construction is indicated in, and universally applicable to, the restoration of the ten anterior teeth, and not infrequently the first molars. Within the sphere of its application it occupies the same degree of general utility, and offers the same assurances of favorable permanency as does the gold crown in the restoration of posterior teeth.

Requirements.

As the application is confined to the range of vision, the requirements in connection with the construction of such crowns may be properly classified as *mechanical* and *esthetic,* and yet in all efforts calculated to be productive of a high degree of permanency and artistic endeavor the two cannot well be disassociated.

Mechanical.

Whilst it is now generally conceded that the addition of a band to dowel crowns affords the previously mentioned advantages, it is also readily acknowledged that the mechanical adaptation, or relation, of the same to the end of the root must be uniformly deep, and close enough to the periphery to preserve the continuity of surface between root and crown at the line of junction beneath and within the free margin of the gum, so that no irritating influence may result. At the same time, it is almost equally essential that the band should be sufficiently *narrow* to be entirely invisible, and thus admit of bringing the porcelain into close proximity with the gingival margin; and yet *strong* enough to retain its given shape and form during the process of fitting and adapting, and when subsequently subjected to the stress of mastication.

The importance of properly trimming the end of the root to begin with, has already been sufficiently emphasized, and is particularly apparent in the shaping of anterior roots, because of their even more conical shape. If this is neglected in the slightest degree, the cervical edge of the band must form a shoulder between it and the surface of the root, which, though hidden by the gum, affords opportunity for the lodgment

and accumulation of food deposits, the subsequent decomposition of which is productive of a decidedly unhygienic condition, and much consequent discomfort. While nature may aid the indifferent, careless or negligent operator for a time, by covering over the evidences of such efforts—and in this connection the tissues surrounding roots supporting artificial crowns cover a multitude of sins—the result is inevitable; hence, *no band at all were better than one which does not fit.*

Esthetics. In the esthetic restoration of the crowns of anterior teeth, success, with all it implies, is codependent upon the ability to observe the minutest details in an endeavor to simulate nature, and that degree of enthusiasm and ambition which prompts a thorough and efficient execution of the artistic requirements involved.

These embrace a consideration of the details of Cervical Curvature, Alignment, Color and Harmony.

Cervical Curvature. In order that the natural cervical curvature of the gum tissue should remain normal, and that no metal should be visible in the finished crown, it is essential that its adaptation should be made with this requirement in view.

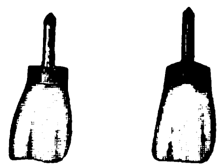


Fig. 122.

A common fault of this kind, the disregard of which materially increases the artificial appearance of the work, as compared with the correct and artistic outline, is illustrated in Fig. 122.

Alignment. The feature of alignment with adjacent teeth is most important, and particularly as applied to the *cervical* half of the crown. A common fault with many crowns, otherwise artistic, is an undue prominence at the neck, which is caused by not cutting the labial portion of the root *short* enough, or by the selection of a facing too thick or bulbous at this point, and the failure to properly reduce it, by grinding, before the completion of the crown.

A proper and equally symmetrical alignment of the incisal end should also be observed, and, while the occlusion may govern to some extent, it is often permissible to grind interfering opposing teeth slightly to admit of securing this. In this connection considerable trimming and shaping

of the ends and uneven and irregular edges of natural teeth may often be done to their improvement and benefit, and entirely without harmful or injurious results, if done carefully and judiciously, such surfaces being afterward polished smooth with fine disks.

Color and Harmony. As nothing in nature is more apparent than the universal expressions of *harmony*, it is, of course, essential in simulating it that every effort should be expended, and every facilitity employed, to obtain this in the construction of artificial crowns, that they may more closely resemble the remaining natural teeth.

Color. The selection of a tooth or facing of the proper color, with due allowances for any change which may be occasioned by the presence of a metal backing, or other means of diminishing its translucency, is often a difficult and very exacting problem, and those who are so unfortunate as not to be endowed with an accurate and artistic eye will often be seriously handicapped.

The color should be selected with these possible changes in view, and, particularly in the restoration of the six anterior teeth, should usually *match the natural tooth corresponding to the one being crowned* (if present), as a variation in the color of natural teeth in the same mouth is marked, to which special attention has been given in a splendid contribution by Dr. E. C. Royce, of Chicago. If some variation seems unavoidable, a slightly *darker* shade is usually preferable to a lighter one, and effects a less conspicuous and in consequence more artistic result.

Oil Colors. The use of the high-fusing oil colors, introduced by Mr. Robert Brewster, of Chicago, or a lower-fusing variety made by C. Ash & Sons, makes it possible to obtain almost any desired variation of shade in a single facing, as well as to more perfectly and artistically imitate the characteristics of the remaining natural teeth. These are prepared in several basal or primary colors, and in obtaining color and shadow effects are to be thinly mixed and painted on the *lingual* surface of the facing, immediately after the grinding has been completed, then placed in the furnace and fused, after which, when the desired result has been obtained, the crown is constructed as intended.

In reproducing pits, grooves, erosion, tobacco stains, etc., the colors are to be painted upon the labial surface, after properly grinding, and then fired before backing.

Harmony. Harmony in shape, form and characteristics is scarcely second in importance to color, and at least in salient features should be closely observed, as the artistic possibilities increase in proportion thereto.

The shape and general form of the porcelain tooth or facing should be the same as the corresponding natural tooth (if present); the length from cervical to incisal edges should be the same as the adjacent teeth; the angles and incisal edge should be characteristic of the remaining teeth, and in the event of the presence of numerous and conspicuous gold fillings the artificial crown should be similarly treated.

Manufacturers' Products.

In complying with such requirements *too* much should not be expected of the manufacturers and supply houses, as it would be impossible for their best efforts to be productive of results which could reasonably be expected to be universally adaptable to all cases. Their products represent only the efforts of the *artisan* in catering to the general *demand,* and the successful operator *only* can and must become the *artist.*

A selection which *approaches* the requirements should be made, and then ground and shaped as the characteristics of the case may indicate. In

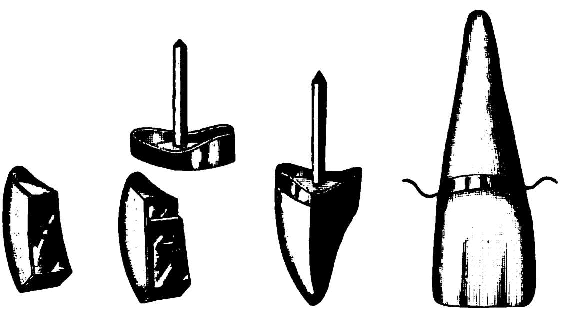


Fig. 123.

nearly all makes of porcelain teeth this can be done with impunity if the surfaces so ground are afterwards repolished with fine disks, and the result is even more natural than the highly glazed surface.

Dental Laboratories.

It is this particular feature that should impel the progressive, conscientious dentist to acquire such skill as may enable him to execute his own work, for the practice of relegating this class of work to *dental laboratories,* where, in the majority of them, the motto observed in making *bands* is to have them *large* enough to admit of easy and ready adjustment; where *cusp-forms* are made by the office boy, by the score; where the *color* is but a chance; where accompanying instructions that the *bite* is *normal* will suffice, and where *time* and *revenue* are necessarily the only serious considerations, should be condemned as materially retarding the progress and advancement of an artistic field of professional effort.

Method of Construction.

In a consideration of the method of constructing this style of crown, the consecutive stages of which are illustrated in Fig. 123, special emphasis must again be given to the essentials of root preparation, and particularly to the feature of allowing the end to project about one-sixteenth of an inch from the gum *until the peripheral trimming has been accomplished, the measurement taken, and the band fitted.*

The importance of this procedure has already been sufficiently emphasized, and cannot be overestimated, as a neglect to observe or a disregard of it will add materially to the difficulties encountered, and to the degree of inaccuracy and discomfiture resulting.

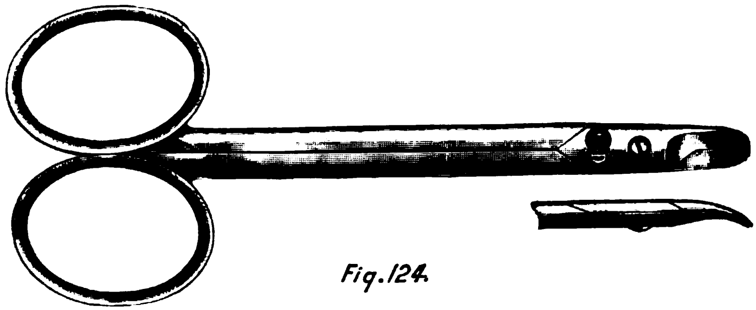


Fig. 124.

Procedure. When the remaining natural crown has been cut to the desired extent, and the projecting end of the root properly trimmed, the measurement should be taken in the manner already indicated.

Bands. A band should now be cut the exact length of the measurement, about *one-eighth* of an inch wide, and of 22 karat gold, 28 or 29 gauge in thickness.

Soldering. The edges should be filed straight and smooth, and the band annealed and made into circular form. By first overlapping and then *abutting* the ends, their contact may be sustained when heated, as already described, and the joint should be soldered from the *inside* with a *minute* bit of 22 or 20 karat solder.

Fitting. The first procedure incident to fitting the band should be to give it a general shape approximating that of the root, and then to trim the cervical edge to closely follow the curvature of the gum, with the joint at the center of the lingual surface. Curved pointed plate shears, or the crown shears espe-

cially designed for such trimming (Fig. 124) may be used for this purpose.

When thus trimmed so as to come in uniform contact with the gum when loosely and temporarily adjusted to the end of the root, the edge should be filed *smooth* with the convex surface of a fine half-round file (Grobet, 4 to 5 inch, No. 5), and then nicely *rounded*, always avoiding a thin feather-edge for the reasons mentioned.

The band should now be placed upon the projecting end of the root, and then forced gently to position with a small piece of wood, until it passes just freely beneath the gum. (Fig. 125, A.)

While the topical application of solutions of cocaine, carbolic acid, etc., are frequently relied upon as a means of obtunding the pain, the use of any therapeutic agent is seldom necessary where the band *fits* a projecting end of a properly prepared root, as this serves to first *conform* it to

a *b*

Fig. 125.

the proper shape, and then *guide* it to place, thus causing little, if any, discomfort. A very great percentage of cases where any acute pain is occasioned can usually be attributed to forcing the band *into* the tissue, instead of its closely following the outlines of the root, and passing under and within the free margin of the gum, without unnecessarily impinging upon the periosteum or peridental membrane.

When the cervical end has been properly adapted, the band should be removed and trimmed until the *labial* surface is as *narrow as possible* to meet the requirements, but gradually sloping until it is somewhat wider upon the lingual.

It should now be readjusted to the root and forced well to place until it is entirely *invisible* from the labial aspect. The root should *then* be ground down until its basal surface follows the outlines indicated and approximates the edge of the band. (Fig. 125, B.)

While this relation may be obtained by grinding the root down with the band in position, it is usually best to remove the band during the procedure, for the reason that it may become loosened from the vibration, and slip downward unobserved, thus endangering the distortion of its shape; or, of being ground too narrow to be useful; and the heat produced by the friction is also an objection to grinding and shaping a band in the mouth.

When thus properly trimmed, it should be removed with a small hook instrument, and the floor then attached.

Forming Cap.

The floor to the band, in the attachment of which the cap is formed, should be *thin* enough to be easily adapted to contact with the edge of the band, and admit of bringing the neck of the porcelain facing into close proximity with the gum.

Fig. 126.

For this purpose, platinum, about 34 gauge, is preferable, as affording the desired thinness without danger of being fused in the subsequent final soldering of the parts; although pure gold, or even gold of 22 karat, of the same gauge, may be used.

Any special degree of strength in the floor itself becomes unnecessary *in gold work,* because of the quantity of solder which will be subsequently used in uniting cap and facing, and properly contouring the lingual surface.

In soldering the floor to the band, a liberal surplus of the metal (gold or platinum) should be used, and will facilitate the procedure. The band should be placed in the center of this, without any special effort to secure a perfect adaptation at this time, the parts then fluxed and attached at *one* point of contact by the *partial* fusion of a small bit of 20 karat solder

placed *outside* of the band. This will anneal the floor metal so that it may readily be burnished to a perfect contact with the edge of the band; and absolute contact around the entire circumference is essential, as an opening or space filled only with solder may be again opened by the re-fusing of the solder in the final assemblage of the crown. In securing this contact, however, care should be exercised to prevent changing the shape and form of the band.

After applying flux, one corner of the floor should be grasped with fine-pointed soldering pliers, and again carried to the flame, until the complete fusion of the solder formerly used unites the parts around the entire joint. (Fig. 126.) It will seldom be found necessary to make a second application of solder, for the quantity required, where good contact exists, is almost infinitesimal.

After the soldering has been completed, the surplus of floor metal should be trimmed close to the band, and the joint then finished down smooth, with stones and disks.

When adjusted to position on the root, the cap should rest firmly upon its seat, and any tendency to rock should be relieved. Rocking usually indicates a high point on the extreme approximal edge, the removal of which will overcome the difficulty.

Dowels.

The cap should now be removed, and the canal prepared for the reception of the dowel, the requirements of which have been already outlined.

As the dowel assumes the greater portion of the strain to which the crown will be subjected, the alloy of platinum and iridium is generally used, because of its toughness and strength; and the round, square and triangular wire, in sizes varying from 14 to 18 gauge, according to that indicated by the proportions of the root, are prepared for the purpose.

The so-called "platinoid" and other German silver alloys are also prepared and used for this purpose, but the only advantage possessed by them is that of economy, and this is gained at the expense of stiffness, strength and permanent integrity.

If there is any preference as to the *form* of wire used, it is in favor of the *round,* because of its being easier to remove from the canal after mounting, in case of necessity; and of its being perhaps also easier to perforate the floor of the cap in such manner as to secure a close contact between it and the dowel at the line of junction, which facilitates and adds strength to their union, and prevents the solder from flowing in upon the under side of the cap. For this reason should a square dowel seem desirable, round wire, of heavier gauge may be used, and that part which

enters the canal filed square after fitting to the hole in the floor but before soldering.

The advantages claimed for the square and triangular forms are that a wire drawn with sharp angles possesses greater strength and resistance than a round one; and that any possible rotation of the crown on conical roots, after mounting, is precluded. If the wire used is of *adequate size to meet the requirements,* the round form possesses sufficient strength, however, and there can be no rotation, if the crown is well adapted and the mounting is secure.

In fitting to the canal a length should be cut which will afford some surplus, and one end then slightly *tapered.* When the dowel has been properly prepared and adapted, the cap should be placed in position and a large round or oval burnisher used to outline the opening of the canal, in the floor. A *small* perforation through the center of this outline should now be made with a sharp pointed instrument, or bur, and the dowel then grasped *firmly* with pliers and the tapered end forced through the floor and into the canal until in proper position, which insures a close contact between dowel and floor.

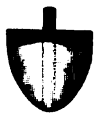


Fig. 127.

When properly adjusted, the relation should be *at once* permanently sustained by soldering, to accomplish which base-plate gutta percha, temporary stopping, or adhesive wax, should be warmed and packed around the projecting end of the dowel, and over the surface of the cap. When this is cool, which may be hastened by a spray of cold water, they should be carefully detached from the root, and the interior of the cap filled with plaster or investment material, until the dowel is covered. (Fig. 127.) The use of any more investment material than absolutely necessary only adds to the difficulty of soldering, and it is essential that it should be packed down into the cap well to prevent burning the band. After this investment has crystallized, the removal of the temporary medium, by warming over the flame, will admit of securely attaching the parts with solder by the use of the small mouth blowpipe.

In the event of accidentally making too large a perforation through the floor, an additional piece of the metal of smaller dimensions may be properly perforated and burnished down over the surface before removing

and investing the cap and dowel, and subsequently attached at the time of soldering.

The cap should be cleaned in the acid bath after removing from the investment, and then adjusted to position on the root and the bite and impression taken.

"Bite." In the construction of anterior crowns, the taking of a "bite" usually becomes necessary only when some abnormality of occlusion, or irregularity of the opposing teeth, presents. Otherwise the lingual contour of the adjacent teeth as represented in the model will indicate the outlines to be followed by this portion of the crown.

When a bite is necessary, it should be taken in wax, preceding the impression, and should be secured in accordance with the requirements of the impression, and in the manner previously outlined.

Impression. The impression should then be taken in plaster for the reasons already stated, and should always include teeth on each side of the one being crowned, and the *corresponding tooth,* when present.

If the projecting surplus end of the dowel is slightly bent, the cap will be removed with the impression, but in the event of its remaining upon the root, it should be detached and adjusted accurately to position, and securely sustained, if necessary, with a little melted wax. *The interior of the cap and the surface of the dowel should now be covered with a slight film of melted wax to facilitate and admit of its ready removal from the model,* and the impression then varnished and filled.

When the model has been obtained, the bite, if one has been taken, should be adjusted, and the case mounted upon the articulator. The cap may now be easily detached by grasping the end of the dowel with pliers, and the wax then removed from its interior, which will admit of its ready and accurate readjustment, thus facilitating the investment of the crown, and permitting the preservation of the model.

In cases where the remaining natural teeth are quite loose, or support artificial crowns of doubtful stability, the use of small particles of wax packed into the interproximal spaces, and into all undercuts, will be found to be advantageous to the removal of the impression, and to the comfort of the patient.

Adaptation of Facings.

Previous to the selection and adaptation of the facing, the surplus end of the dowel should be cut off with excising forceps or cutting pliers, leaving it as long as possible so as not to interfere with the adjustment of the facing to its proper position.

As the floor is very thin, however, some little surplus should always be allowed to remain, in order to add strength to the attachment of the dowel.

A long pin facing should now be selected and ground to a *perfect joint* with the cap, along its cervical curvature, and then to meet the requirements of length, contact and characteristics.

Cervical End. When this required and proper adaptation of the cervical end, to the cap, is secured, the *inner* surface of the facing should be thinned down somewhat until sufficient space exists to afford opportunity for securing a close joint between the backing and the cap, with solder.

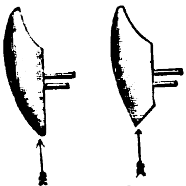


Fig. 128.

Incisal or Occlusal End. The incisal or occlusal end should now be beveled about half-way to the pins, in order that it may present a *smooth, sharp angle,* instead of the usual rounding edge. (Fig. 128.) This becomes necessary as a means of affording a definite edge to which the backing may be subsequently finished.

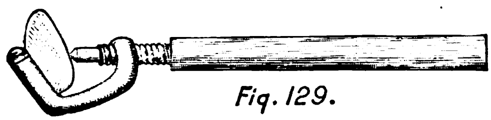


Fig. 129.

The use of the *clamp* designed by Dr. A. Brom Allen, of Chicago (Fig. 129) will be found convenient for holding porcelain facings while grinding.

Backing of Facing.

The backing of porcelain facings becomes necessary in metal work as a means of supporting them, by affording a surface which will admit of their subsequent attachment with solder.

The requirements in this connection embrace *two* essential features: First, the backing must be *closely* adapted to the porcelain, and, second, it must be sufficiently strong, rigid and unyielding, to protect the porcelain from the strain of mastication

While numerous methods are employed, the following will be found

to be productive of the most certain and accurate results, though possibly somewhat less expeditious than the more simple methods usually observed.

Pure gold, about 34 gauge, cut somewhat larger than the facing, and to extend from cervical to incisal or occlusal edges, should be perforated for the ready reception of the pins, annealed, and carefully burnished to a perfect adaptation.

As it is desirable that the perforations should be properly placed, so as to admit of the free and easy adjustment of the porcelain to position, and to preclude any strain upon the pins in adapting the backing, it should first be observed that the pins *are straight and parallel with each other,* and that this surface of the porcelain is clean and free of wax.

Adaptation.

As a means of ascertaining the exact position of the pins, the gold should be laid on a smooth surface and the facing placed over it, pins downward, and sufficient pressure applied with the thumb to make a slight indentation.

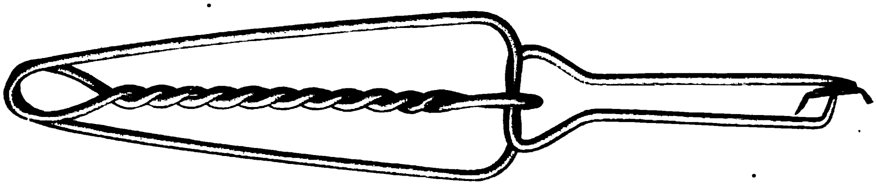


Fig. 130.

The perforations may now be made with a punch designed for the purpose, or with a sharp pointed instrument of proper size. The use of the latter possesses the advantage of throwing up a small furrow of metal around the holes, and is preferable.

The Acme Backing Forceps.

Or, a very accurate adaptation may be made by employing the "Acme Backing Forceps," which are so constructed as to both perforate and adapt the backing directly to the facing.

After annealing and burnishing the gold to a perfect adaptation, the surplus should be trimmed away to closely follow the porcelain on all surfaces *except* the *incisal* or *occlusal,* where a slight projecting edge should be allowed to remain.

While the requirement of *adaptation* has now been complied with in the best and easiest possible manner, that of *strength* is yet to be observed.

Re-enforcement.

As the strain upon a facing is generally applied directly upon the end, and then diverted to the point of resistance afforded by the pins, it is necessary that a *uniform re-enforcement* extending over this area should be made.

To best obtain this, and thus combine the requirements of *adaptation and strength,* a second piece of gold, preferably about 22 karat, 29 or 30

gauge, should be perforated, burnished to place, and trimmed *to extend from the pins to the incisal or occlusal end only,* with a corresponding surplus at the latter point.

Soldering. The two backings should now be adjusted to position on the facing and reburnished, then removed, placed together with the holes approximating each other, which is facilitated by the furrow of metal produced by being punched with a sharp instrument, and then attached with 20 or 18 karat solder. Small pieces of the latter should be consecutively applied to the joint between the two, presenting toward the cervical end, until the intervening space is completely filled, which may be easily and quickly accomplished by grasping the backings with the soldering pliers, as indicated in Fig. 130, the use of which securely sustains their relation, and precludes any distortion of shape.

The use of an excess of flux should be avoided, and care must be exercised to prevent the solder from filling the perforations, or flowing through to the under side of the backing, and thus destroying the adaptation. The latter may be easily avoided by coating this surface with a solution of whiting, but is usually prevented by the upturned edges surround-

Fig. 131.

ing the perforations, which also generally precludes their filling up with solder. The use of small pieces of graphite from an ordinary lead pencil trimmed to snugly fit, and to project slightly from each side, will also overcome any such tendency.

When the soldering has been completed, the backing should be cleaned in acid, adjusted to position on the facing (Fig. 131, A), and securely retained by bending the pins down close upon it, as indicated in Fig. 131, B. Care must be exercised in bending the pins to catch them with pliers at the *extreme end,* in order to avoid any *stress* or *tension* which might result in immediate or subsequent fracture of the porcelain.

Finishing. In finishing, the gold should be trimmed down to close contact with the porcelain around all surfaces. This should be started with a fine file, always carrying it *toward the porcelain;* and completed with disks, to insure the re-

moval of all *overhanging edges,* the presence of which *will invariably cause fractures* of the porcelain along the edges, due to the impingement afforded by the shrinkage and contraction of the metal after soldering.

In trimming away the surplus from the incisal or occlusal portion the file should be held on a *parallel line* with the *labial* or *buccal* aspect of the facing. This leaves the backing its full thickness along this edge, the vulnerable point, when it may be afterward *rounded* nicely until practically invisible, and yet always remain sufficiently long and strong to afford ample protection to the porcelain. (Fig. 131, C.) Much of the artistic effect of the finished crown will depend upon obtaining and preserving a *perfect joint* between the neck of the facing and the cap, and while it is the usual practice to grind this portion of the facing thin, and allow the backing to extend entirely over it, forming a joint with the cap which is subsequently filled with solder, the best results may be secured by filing or grinding away this edge of the backing until the *edge of the facing may be placed in direct contact with the cap.*

This admits of bringing the facing into closer proximity with the gum and of securing a better and more perfect joint between backing and cap, because of the difficulty and uncertainty usually experienced in successfully filling this space with solder.

The use of the clamp previously mentioned may also be found serviceable as a means of holding the facing while finishing the backing.

Variation in Method. As the double backing may seem unnecessarily difficult or circuitous, various other methods are employed in preference, but probably with results less certain and accurate.

The re-enforcement of the single pure gold backing may be done with a lower grade of gold, or with solder alone, either preceding its final adaptation to the porcelain, or at the time of soldering the facing to the cap. There is no objection to this procedure if *adequate* re-enforcement is secured, but as gold or solder in fusing flows to a *thin edge,* the *edges* of the backing and particularly the incisal or occlusal, where strength is demanded, are quite naturally the thinnest, and consequently the weakest portions.

This may be overcome somewhat by allowing a slight surplus to extend beyond the porcelain, especially upon the incisal or occlusal end, until after re-enforcing, and then adjusting to position on the facing, and securely attaching and finishing, as indicated. In no event, however, when a single pure gold backing is used, is it advisable to defer the re-enforcement until the final soldering of the crown.

Where a single backing seems indicated or desirable, it should be made of 22 karat gold, about 28 or 30 gauge, but as the burnishing to the

porcelain is thus made more difficult, the additional stiffness and strength is usually obtained at the expense of the adaptation.

The adaptation of heavy single backings may be materially improved by swaging. For this purpose a mould of the lingual surface of the porcelain should be secured in mouldine, and fusible alloy dies obtained, and dies made of ordinary sealing wax, or hard modeling compound are also sometimes used, or, the facing itself may be imbedded in either of these, the backings perforated, and then swaged to them with a soft rubber plunger.

Use of Platinum. As porcelain facings are more or less transparent, the presence of a gold backing is frequently objectionable in the blue and lighter shades, because of the yellowish cast imparted to them; hence the placing of a surface of platinum next to the facing is sometimes indicated as a means of preserving the original color, or of effecting the least, or most desirable, change in it.

For this purpose, *platinized gold* is employed, and possesses the advantage of affording a surface of either gold or platinum, as the case may require. A more convenient method, however, is to back up the facing in

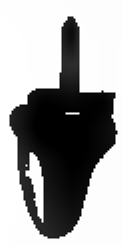


Fig. 132.

the usual manner, and then insert a piece of platinum foil (1-1000) over the desired area between facing and backing, just previous to permanently attaching them by bending the pins, and finishing the backing to its proper adaptation; by which means equally good and perhaps quicker results may be obtained.

Investing. When the adaptation and finishing of the backing have been completed, the facing should be adjusted to position on the cap, and the proper relation sustained with wax. The crown should now be removed from the model, and the joint between cap and backing well filled with melted wax. This keeps it clean and free of investment material, which is essential to securing a smooth flush joint with solder, and the latter may be facilitated by using *fluxed* wax.

Investment material should now be mixed to a thin plastic consistency, and a sufficient quantity poured upon the surface of a clean piece of paper. The *interior of the cap* should first be *thoroughly filled*, and the

crown then gently forced into the investment, until only the wax remains exposed. After hardening, the surplus should be trimmed to the outlines indicated in Fig. 26, and the wax carefully removed with a small pointed knife-blade, being particular not to loosen the facing in its matrix.

In those cases where the backing has been allowed to extend entirely through between facing and cap some difficulty is occasionally experienced in getting the solder to flow nicely into the joint, and while this may usually be accomplished by properly fluxing and heating the case before attempting to solder, if the proximity of the surfaces is very close the same may be greatly facilitated by placing a small projecting bead of wax around the immediate outside of the joint, before investing (Fig. 132, A). When melted and subsequently absorbed and burned out, this leaves a small space into which the heat becomes concentrated, during the process of soldering, and this aids materially in drawing the solder toward that point.

The cutting of a small opening through the *under* surface of the investment until the joint is *exposed* is also recommended for this purpose, and the same may be easily obtained by extending the bead of wax previously mentioned until it is of proportions sufficient to leave such an opening after its removal. (Fig. 132, B.)

In cases where two or more individual crowns, approximating each other, are being constructed at the same time, they should always be invested *separately,* as it is often quite difficult to solder them, when contained in the same investment, without attaching them together.

Soldering.

Previous to heating the case for the purpose of final soldering, and after the investment has been properly trimmed, and all debris removed, liquid flux should be applied to the surface of cap and backing, and worked well down into the joint. If the latter is done after the case is heated, or if powdered flux is used, its penetration to the full depth of the joint is made more doubtful.

The case should now be placed over the flame and *gradually heated until red,* when medium-sized pieces of solder, previously fluxed, should be separately and consecutively applied, and fused, until the joint is first filled, and the desired contour obtains. If the case is *properly heated,* this can be easily and readily accomplished with a small pointed flame from the blowpipe.

When the soldering has been completed, the crown should be allowed to cool slowly by gradually diminishing the size of the flame under it, until it may be turned off entirely. Many prefer to place the work in a cooling oven, or to submerge it into dry plaster until cold, but either procedure is entirely unnecessary.

Finishing. After cooling sufficiently, it should be removed from the investment, treated to the acid bath, and then finished with stones and disks in the engine, and subsequently polished on the lathe, when it is ready for mounting.

Application of Partial Bands.

The application of a partial band encircling only the approximal and lingual surfaces of the root is advocated and employed more or less frequently in the construction of dowel crowns, as a means of avoiding the presence of a labial band, from an esthetic standpoint, and of precluding its possible irritating influence, as a prophylactic measure.

Comparative Advantages. A consideration of the comparative advantages leads to the conclusion that, while a band encompassing the entire circumference doubtless adds greater stability to the attachment of the crown, affords a more perfectly hermetical sealing of the end of the root, overcomes the possibility of fracture, may be made practically invisible, and will not necessarily prove a source of irritation, providing that it *fits,* the *partial* band, if well adapted to the *lingual* and *approximal* surfaces, fortifies the attachment against stress in the direction from which stress is exerted, makes it possible to bring the facing into *absolute* and *direct* contact with the tissue, and precludes *any* irritation at this point, or the conspicuous and objectionable appearance of the band in the event of subsequent recession of the tissue.

Indications. The indications for the application of this mode of construction are more or less *general,* but depend much upon personal experience and preference, combined with a careful observation of the particular requirements of the case under treatment.

Of special indications, the most favorable are those cases where the root is sufficiently strong to insure permanent support to a crown; or where the labial portion of the root may have been destroyed to the border of the alveolus; where the extreme shortness of the crown, or the thinness and transparency of the tissue surrounding the root, would likely show the presence of the band; where recession of the gums has exposed the labial portion of the root; and where pathological conditions already exist, or the tissue may seem to be particularly susceptible to any possible irritating influence.

Procedure.

While several methods of securing the desired adaptation are em ployed, the most positive and accurate results may be obtained by fol-

lowing the same detail of procedure indicated for a circular band, up to and including its fitting, shaping and trimming, as previously outlined.

When the band has been thus fitted and trimmed, a floor of platinum or pure gold, about 34 gauge, should be first simply attached to the lingual *surface* by the *partial fusion* of a small piece of solder. The floor should then be adapted closely to the entire edge of the band, and a precautionary measure observed to prevent their union with solder along that edge of the band which is to be subsequently cut away. To accomplish this, such portion of the joint between floor and band should be filled with a solution of whiting, or occupied by a *thin* piece of *mica* (Fig. 133 A) and the soldering completed around the approximal and lingual surfaces.

The surplus floor metal should be trimmed off on a line with the band, and the labial portion of the latter cut away to the desired point with curved shears, always leaving the edge nicely rounded. (Fig. 133 B.)

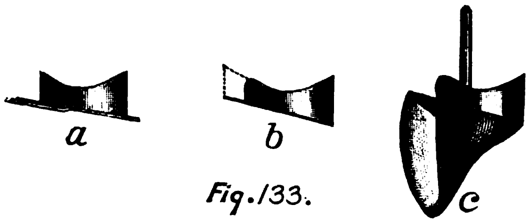


Fig. 133.

When the trimming and finishing of the cap have been completed, it should be adjusted to position on the root, and the projecting labial portion of the floor burnished to a close adaptation to the surface and to the peripheral outline.

The dowel should be fitted and subsequently soldered, and the impression then taken, and the crown completed as already outlined. (Fig. 133 C.)

The Sanger Crown. Another method of constructing this type of crown has been devised by Dr. R. M. Sanger. In this procedure both the partial band and base of crown are made of one piece of metal, and formed in such manner as to admit of easy and accurate adjustment by means of pliers of special design.

Application of Riveted Facings.

Because of the apparent *dread* exhibited by those of limited confidence or experience, toward the process of soldering anything necessarily involving porcelain, for fear of checking it, and of its possible change of color as a result of the application of heat, a method has been devised

whereby the occurrence of either or both of these objectionable features might be entirely and positively eliminated.

The process defers the permanent attachment of the facing to the backing until after the construction and assemblage of all the metal parts of the crown, after which it is then securely anchored by *riveting* the pins.

While there are probably no particular objections to this method, except that the facing is held less rigidly, there are no special advantages apparent because of the *limited* possibilities of checking facings, which have been previously mentioned in connection with "Soldering," and of the fallacy of a probable change in color resulting from the heat of soldering.

That any perceptible change of color is due mainly to the presence of the *backing, and not to the heat,* is proven in porcelain work, where, when necessarily subjected to a very much higher degree, it is even then the rare and exceptional occurrence; and it would also seem that the

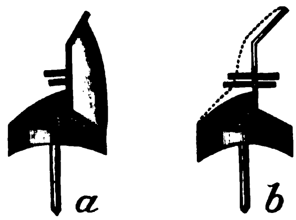


Fig. 134

impact and vibration produced by subsequently riveting the projecting ends of the pins down close upon the backing would be equally as *"hazardous"* a process as that of soldering.

Procedure.

In the construction of crowns by this method the same general details as previously outlined are observed up to and including the adaptation of the backing.

When this has been accomplished it should be adjusted to position on the facing and finished down as desired, in the usual manner, *except* that the pins are *not* bent to sustain the relation of the two during the process.

Facing and backing together are placed in proper relation to the cap and sealed with a small quantity of hard or adhesive wax in such manner as to securely attach the backing, but to allow the projecting ends of the pins to remain freely exposed. (Fig. 134 A.)

The crown should now be gently removed from the model and the facing carefully detached from the backing.

Small pieces of graphite trimmed from a lead pencil are then closely fitted into the holes in the backing and allowed to project far enough on each side to be securely held by the investment, and to admit of properly forming the lingual contour with solder without being covered over. (Fig. 134 B.)

The remaining incisal portion of the lingual surface of the backing should be covered with wax to keep it clean, and the crown invested. Upon the subsequent removal of the wax the parts should be freely exposed, fluxed, heated and soldered as usual, being careful to note that the ends of the graphite pins are not covered, and that the solder does not penetrate to the under surface of the backing, which is prevented by painting around the pins with whiting.

Fig. 135.

When the soldering has been completed, the graphite may be broken off even with the surfaces and removed from the holes by the use of a sharp pointed instrument or bur of the same diameter.

The facing should now be adjusted to position and the lingual surface of the crown trimmed to allow a free exposure of the projecting ends of the pins. The holes should then be slightly countersunk with a round bur, the crown roughly finished with stones and disks, and the facing finally adjusted for riveting.

Riveting.

As a means of facilitating the process of riveting, and of lessening the liability of fracturing the porcelain, the riveting forceps designed by Dr. Frank A. Brewer, Sr., may be used to advantage; or the crown may be invested, facing downward, in a base of plaster about an inch in depth (Fig. 135) and the riveting hammer used. In the latter method the projecting ends

of the pins are flattened down over the backing separately, with moderate and well-directed blows from a small riveting hammer. If the crown is properly invested, with a sufficient depth of plaster beneath and supporting the facing, and the whole rests upon a firm seating, this may be done without danger of fracturing the porcelain. The riveted ends are then smoothed down with disks and the crown finished and polished, burnishing the metal up close to the porcelain around the edges.

Application of Detachable and Replaceable Facings.

The not infrequent presentation of broken facings resulting after the permanent mounting of the crown, combined with the more or less difficult operation of replacing them in a secure and artistic manner, has resulted in the introduction of various means for overcoming the former and simplifying the latter.

Several varieties of detachable and replaceable facings are designed for this purpose, and are applicable to the construction of dowel crowns as well as bridgework, though perhaps more generally so to the latter.

While, as a usual thing, it must be granted that the subsequent fracturing of a porcelain facing is due to one of two causes, i. e., either faulty adaptation of the backing, wherein it affords insufficient strength or inadequate protection, or a total disregard of the requirements of occlusion, the use of a style which is easily replaceable is doubtless an advantage in some instances.

When these common faults in regard to backing the facings are combined with the severe strain to which the porcelain is often subjected in some conditions of occlusion, and the perhaps unnecessarily rough usage sometimes unconsciously accorded them, any practical means of facilitating repair in the event of accident is materially useful.

Advantages Claimed. The advantages claimed by the advocates of this style of facing are: First, that the porcelain is not subjected to the heat of soldering; second: facings may be more easily replaced in the event of becoming fractured; third: the probability of becoming fractured from usage is greatly diminshed because the facing is not so rigidly attached to the metal backing; fourth, the color is not changed.

Advantages Considered. The *first* point made is practically the *weakest*, because the fracturing of a facing during the process of soldering it to any kind of an attachment is inexcusable, and can be invariably attributed to either a lack of skill or a neglect of detail.

The *second* must be regarded as problematical, at least in the manner

in which these facings are ordinarily used, for the reason that it is often impossible to properly adapt any style or kind of facing to the individual case without considerable grinding.

For this reason also the subsequent replacement of even an exact duplicate of the same mould would occasion the necessity for grinding the latter to an accurate fit and adaptation with the stationary backing, and to meet the esthetic requirements, which, irrespective of the manner of attachment, is not usually an easy or simple procedure.

The *third* feature presents the most practical and plausible advantage, because a porcelain facing supported by mechanical means supplemented with an intervening medium such as gutta percha, or even cement, which affords a somewhat cushion-like effect, will withstand greater stress than one held firm and rigid. Hence fracture is, of course, less likely to occur since the facing will yield slightly to stress before breaking.

The *fourth* point of advantage is doubtful, for the reason that any change of color is usually due to excessive heat, or the presence of the backing, as has been previously mentioned.

Advantages Obtainable. If the highest advantages are to be obtained in the use of this style of porcelain facing, the adoption of a method suggested and practiced by Dr. F. T. Van Woert and others will be found most practicable. This consists of properly grinding and adapting two or more facings of the same color and mould, as the conditions of occlusion may seem to indicate, for each case at the time of construction. Those not used in completing the crown are then placed in small boxes or other convenient receptacles and labeled with the patient's name. In case of breakage occurring at any subsequent time, a duplicate requiring no fitting or grinding, and which may be readily adjusted to position, is conveniently obtainable.

While such a procedure may involve considerably more work at the time, much may often be saved in the long run, and particularly in difficult cases, where much grinding is necessary.

Various Designs.

Of the various designs of detachable facings now procurable, the demand has seemingly not justified the adoption of any one special make in preference to the others, nor their extensive manufacture in any great variety of moulds and colors.

Mason's Facing. The design of removable or detachable facing devised by Dr. W. L. Mason, of Red Bank, N. Y., is probably the most extensively used. It consists of a heavy gold backing having a triangular *slot* through the center and a facing with a projecting corresponding triangular platinum *bar* extending

longitudinally, through the center, which readily telescopes into the slot in the backing. (Fig. 136 A.)

These facings are obtainable in a fairly good variety of moulds and colors, and the principle of attachment is secure and admits of easy adjustment. The objectionable features lie in the seemingly excessive proportion of platinum baked in the porcelain, which doubtless weakens the latter by dividing it through the center, and in the necessary thickness at the incisal or occlusal end.

Application. In the application of this style of facing the cap should be completed as prescribed, and the models obtained and mounted upon the articulator. After the selection of the facing its backing should be adjusted and two facings, *in situ,* ground to fit the cap and to conform to the usual requirements. When the desired adaptation is secured the relation to the cap should be sustained by attaching the backing to it with hard or adhesive wax, and the facing then detached, which is facilitated by a projecting end of the platinum bar


a Fig. 136. b

at the incisal or occlusal edge. Care should be exercised in securing a close relation between the backing and the cap, in order that any penetration of solder through the joint may be precluded, and this may be further prevented by filling the slot and coating backing with whiting. The metal parts should now be invested and soldered, with due attention to the desired lingual contour.

After soldering, the crown should be finished (Fig. 136 B), and the facing then adjusted to position. The projecting end of the platinum bar should now be cut off and the facing attached to the backing with a thick solution of gutta percha in chloroform, after which the edge should be finished up close to the porcelain, and the crown mounted. Or, if desirable, the setting of the facing may be made after the crown has been attached to the root and cement is also some times used.

Roach's Facing. Another design of removable facing has been devised by Dr. F. E. Roach, of Chicago, and for simplicity and strength, combined with accuracy of adaptation, and ready application to either individual crowns or dummies for

bridgework, it presents many favorable features. The design consists of a facing with a dovetail lug extending lingually, which is stamped of one piece of iridio-platinum (Fig. 137 A), and a backing with a slotted diaphragm into which the lug fits accurately (Fig. 137 B).

The *lug* is placed vertically in the body of the facing, and, being entirely surrounded by porcelain, affords to the latter a maximum degree of strength, and is set at an angle which admits of easy adjustment to the backing.

The backing is composed of two parts securely united. The outer portion, which is of pure gold, about 34 gauge, is intended to facilitate ready and accurate adaptation to the porcelain, after grinding; and the central portion, which affords the means of attachment, is in the form of a slotted diaphragm, made of 26 gauge clasp metal.

While the principle of attachment is good and secure, the pliability of the outer backing insures a close adaptation to the surface and edges of the porcelain; the gingival extension admits of a close joint between

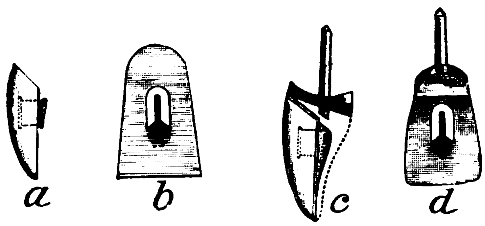


Fig. 137.

facing and cap, and no excess metal exists at the incisal end to offer obstruction to the occlusion, the merits and demerits of these facings, and their possibilities, range of usefulness and general application are at present uncertain, because of the limited supply and selection procurable.

Application. After constructing the cap and obtaining models, the facing should be selected and ground to place, closely following the method previously outlined with regard to the cervical and incisal preparation. The backing should then be adjusted to place on the facing and burnished to a close adaptation with the porcelain, after trimming away all unnecessary surplus around the edges.

The two should then be placed in position on the cap and the relation sustained with hard wax (Fig. 137 C), the facing removed and the metal parts invested and soldered (Fig. 137 D).

After finishing the crown the facing should be attached with cement, or gutta percha, and the crown mounted. Because of the extreme thinness

and pliability of the backing surrounding the attachment, this style of facing is also applicable to the construction of the shell or telescope crown with porcelain facing, and to bicuspid and anterior dummies for bridgework.

Dwight's Facing. Another design has recently been devised by Dr. W. H. Dwight, of Le Mars, Iowa. This consists of a facing containing a countersunk platinum socket, which engages the arms of a bifurcated spring post, with threaded shank, which is to be previously attached to the backing (Fig. 138 A).

Application. In the application of this principle the cap should be constructed as indicated, and the models secured. The facing should then be selected and ground to place with the incisal end properly beveled to afford protection. By *heating the facing* and pressing its labial or buccal surface against a small piece of ordinary sealing wax it may be conveniently handled during the process of adaptation.

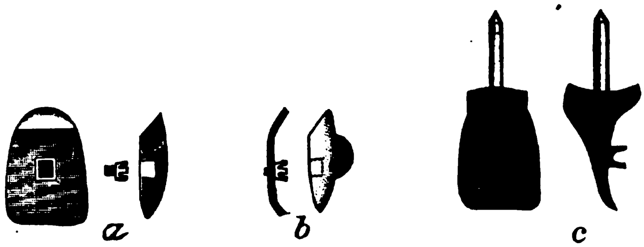


Fig. 138.

When the grinding has been completed the spring post should be inserted in the socket of the facing and the end of its projecting shank imprinted in the surface of a piece of pure gold, about 34 gauge, to denote the location of a perforation for its reception.

The perforation should then be made with a punch or small sharp-pointed instrument, and the projecting threaded shank screwed into it until the backing approximates the shoulder of the post. This may be facilitated by leaving the facing attached or by the use of a wrench designed for the purpose. The facing should then be removed (Fig. 138 B), and post and backing permanently attached by the use of a small quantity of solder fused around the line of junction upon the surface to be placed *next to the porcelain,* in order to stiffen and strengthen their union.

The facing is now replaced and the backing burnished and trimmed to a proper adaptation with the porcelain and then placed in position on the cap and the relation sustained with hard wax.

After removing the porcelain the inner surface of the backing should be coated with a solution of whiting and the parts invested, soldered and finished (Fig. 138 C). In permanently attaching the facing to the crown the arms of the post should be expanded until it becomes necessary to use some little pressure in forcing it to place, as they are purposely left slightly contracted, in order to admit of easy adjustment during the process of adaptation.

The facing should then be cemented to place and the crown polished and mounted.

The same principle is also applicable to the replacement of broken facings on crowns otherwise constructed, and will receive subsequent consideration in that connection.

While the details are expeditious and simple, the principle involved in this style of attachment seems weak, from the fact that the mechanical fixation is insecure, and depends much upon the presence of cement for the necessary strength.

Bryant's Method.

The method of constructing a replaceable facing, devised and practiced by Dr. Emory A. Bryant, of Washington, D. C., consists of forming a *box* for the accommodation of the pins as a portion of the backing, and is applicable to any size of the ordinary cross-pin flat-back facings, and to the construction of bridgework as well as single crowns.

Application.

In the application of this method the facing should be selected and ground to the proper and desired adaptation, after which it should be backed with pure gold or platinum (34 to 36 gauge), as the requirements of construction may indicate.

Box Method.

In the box method a pair of Barnard's parallel pliers, modified by the addition of a set screw and by grinding down the ends of the beaks to approximate the diameter of the pins of the facing, as indicated in Fig. 139, are now accurately adjusted to the relation of the pins, and a strip of platinum, 36 gauge, somewhat wider than the length of the pins, is then wrapped around the points of the pliers, forming a box for the reception of the pins.

After soldering the joint, backing and box are adjusted to position on the facing, and their relation marked with a sharp-pointed instrument, after which they are removed and attached by soldering. The two perforations for the pins should now be extended into one by cutting out the metal between them with a fissure bur of about the same diameter (Fig. 140 A).

This should then be readjusted to position on the facing, and the inner

edge of the box, and the ends of the pins trimmed to approximate, and until the projection offers no obstruction to the desired contour or occlusion. A cover of 22 karat gold, about 28 gauge, somewhat larger than the box, is soldered to this edge from the outside, and subsequently trimmed until all surplus is removed, which completes the construction of the backing. (Fig. 140 B.)

The facing should be prepared by slightly serrating the surfaces of the pins which present toward each other, and then filling the space between them with soft solder, using enough to fill it at least equal to the length and thickness of the pins.

Fig. 139.

This may be easily done by first fluxing the pins with soft solder flux, placing the soft solder or fusible alloy in position, and carefully directing the flame upon the porcelain, until it takes hold of the pins, after which it should be quickly plunged into cold water to preclude an expansion of the pins, which might cause fracture of the porcelain. Or the facing may be placed on a charcoal block or asbestos pad, pins upward,

Fig. 140.

and the solder fused by carefully directing a small flame upon the porcelain.

This extension of soft solder should be filed down even with the pins on all surfaces (Fig. 140 C), except that the extreme end should remain a shade heavier or thicker, to facilitate the subsequent attachment to the backing with cement.

Facing and backing should be adjusted, placed in proper relation with the cap and temporarily attached with hard wax. The facing should then be removed and the box filled with moistened whiting, and a staple of German silver or iron wire inserted, with the ends projecting about one-quarter of an inch. This prevents the solder from penetrating the interior of the box, and precludes any change in the relation of box and backing during the process of soldering The parts should be invested, soldered and finished as usual and the facing then mounted with cement.

Tube Method. A similar method involves the like adaptation of a *separate tube* to each individual pin, but as this entails much more work, possesses less strength and affords less opportunities for replacing the facing in case of accident, it has been almost entirely superseded by the former procedure.

The merit possessed by these methods lies in the facility with which a replaceable facing and its attachment may be constructed, and the main advantage in their use may be attributed to the fact that the facing is not held so unyieldingly rigid as if soldered.

The Boos Method. Another method of greater simplicity and increased practicability is known as the "Boos" Method. This also involves the use of ordinary long-pin facings, but the method of forming the attachment to the backings is much easier and quicker, as well as being equally secure. Its application, however, together with the similar use of Davis crowns, will be subsequently considered.

Application to Bicuspids and Molars.

The band and dowel style of construction is applicable to the restoration of the crowns of bicuspids and molars as well as to the anterior teeth, but is more generally indicated and more extensively employed upon bicuspids than upon molars.

Indications. While it is especially indicated in *porcelain work,* where the root is necessarily and purposely trimmed to approximate the gingival line, it is also indicated in combination with gold, in order that the work may more closely approach the highest esthetic requirements. In this connection, and in the absence of facilities for doing porcelain work, a facing, or saddleback or rubber tooth may be used with artistic results, and particularly where the shortness of the root demands the employment of a dowel attachment, in preference to restoring its coronal proportions with amalgam, and using a shell or telescope crown.

Bicuspids. The application is more generally indicated and more practical on the bicuspids, because of the necessity for observing higher artistic possibilities, and of the objection to placing gold crowns upon these teeth.

Molars. In the restoration of molars, however, the indications are not so general, and the range of application is more limited, for the reasons that such crowns are usually beyond the range of vision, at least to an extent which greatly diminishes the esthetic requirements; that they are subjected to more vigorous strain in the act of mastication, and that a telescope attachment to a projecting end of the root doubtless affords greater strength and

more permanent stability than is usually obtained by cutting the remaining root down to the gingival line and using a dowel attachment.

It is claimed by some, however, that the preparation of a *short* root and the subsequent adaptation of a *narrow* band, with accuracy, is so facilitated as to present advantageous features, as compared with the more extensive preparation of the remaining coronal proportions of the root for the shell or telescope crown.

Yet such a claim reverts to the manner of the execution of the necessary details, and as they must be carefully and skilfully observed in *either instance,* the advantage seems more hypothetical than practical, and the judicious preservation of tooth structure combined with the stability of attachment as applied particularly to the molar teeth, for the reasons mentioned, should precede a consideration of *facility and possible advantages* in the construction.

Procedure.

In the construction of this style of crown, in combination with gold, *two* more or less practicable methods are employed, and they differ only in the style of porcelain facing or tooth used. The cap should be completed as though for an anterior crown, as described, and the dowel fitted and soldered.

Reenforced Cap. Where a heavier and stronger cap than will be afforded by the thickness of the band is indicated or desirable, the same may be obtained by allowing the floor to extend or project about $^1/_{32}$ of an inch from the band, and then filling in until flush and smooth with 22 or 20 karat solder. This will result in a cap possessing good adaptation, a maximum degree of strength and a minimum tendency to cause irritation, such as is frequently indicated in the restoration of bicuspid crowns.

Use of Two Dowels. If the use of two dowels should become necessary to insure sufficient stability, care should be observed to have them inserted at such an angle as to pass into the root readily, and yet project through the floor of the cap at a point at which they will offer little, if any, obstruction to the proper adjustment of the facing. While the surplus ends may be cut away reasonably close to the floor *after soldering,* the longer they may be allowed to remain the greater the strength of their attachment to the crown.

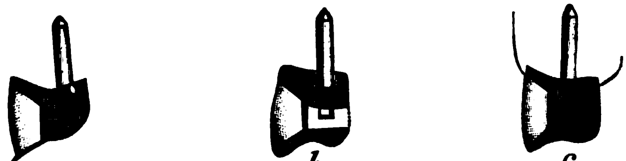
Bite and Impression. The bite and impression should follow in the usual manner, and the models then be obtained and mounted upon the articulator.

Use of Flat-Back Facing.

The method perhaps most usually employed involves the use of a flat-back facing and gold cusps, and while this style of construction possesses the advantage of strength, it also presents the objectionable feature of the presence of an occlusal surface of gold.

Facing. The facing should be selected and ground to position on the cap, and the occlusal end then ground to allow for the presence of the cusp, and properly *beveled,* as indicated. It should then be backed up with a single backing of pure gold, about 34 gauge, which should be closely finished down to the edges at all points, *except* on the *occlusal,* where a slight projecting surplus should remain.

Cusps. Facing and backing should now be placed in position on the cap and sustained with hard wax (Fig. 141 A), while the cusps are being formed and fitted by whatever method selected.



a b c

Fig. 141.

These may be accurately obtained by allowing one or both of the pins to project away from the backing, pouring soft plaster into the space and up against them, and closing the articulator, and then subsequently carving them and securing dies in the manner already outlined. The pins are allowed to project as a means of securely sustaining the plaster during the process. Or the cusps may be obtained from any of the die and die-plate systems.

Adaptation. After swaging, the buccal portion of the gold should be cut away to the occlusal angle on a plane which will admit of approximating it with the edge of the facing and backing. This will leave only the thicknesses of the gold forming the cusp and the backing along the occlusal edge, but the same will afford ample protection to the porcelain, and admits of a more esthetic result.

After thus trimming the cusp to adaptation with the porcelain the two should be adjusted to the cap with wax and adapted to the articulation and occlusion. (Fig. 141 B.)

While all soldering may be done at the time of uniting cusp, facing and cap, it is usually best to remove the *cusp* and *facing* in their proper relation, and previously invest and attach them with a sufficient quantity of 20 karat solder to effect union and fill the lingual portion of the cusps.

To preclude the checking of the facing along the edge, as a result of the impingement of the cusps occasioned by the shrinkage of the solder, a *slight space* should be allowed between the backing and cusps, and this filled with wax to prevent the investment material from running in.

Approximal Restoration. When the parts are securely sustained with wax enough should be further added to form the proper approximal contour to secure a restoration of contact, and a small piece of pure gold, about 36 gauge, should then be *adapted* or burnished to each *approximal* side of the crown, extending from cusp to cap, and held in place with the wax. This forms a matrix which facilitates soldering and gives the desired approximal contour, but should not extend over the lingual portion of the wax, as the solder must be subsequently added from this point.

Foil gold, No. 60 or 120, may also be used for the same purpose, if desired.

Investing. The crown should be invested with a slight covering over and up to the edges of the pure gold matrices to hold them in place, but with the lingual surface freely exposed. When the investment has been properly trimmed, the wax should be carefully picked out and the remainder removed by pouring boiling water upon it, and the parts then fluxed and heated.

Soldering. The soldering should be done by the consecutive application of small pieces of 18 karat solder, of a size suitable to be readily dropped into the opening. Small balls of scrap gold and silver are sometimes used to aid in filling in when the space is of considerable size, and the use of the same facilitates the procedure and lessens the extent of shrinkage which would take place in the use of solder alone. The use of balls of German silver or copper is also permissible if they are well and completely covered over with the gold solder.

In finishing, care should be exercised to preserve the approximal contour, in order that contact may be properly restored and the crown then polished and mounted. (Fig. 141 C.)

These crowns are sometimes constructed without cusps, but such practice is to be condemned, except in rare instances on first bicuspids, because the usefulness of any crown is usually equal in importance to cosmetic effect.

Use of Saddle-Back Teeth.

A variation of method consists in employing the so-called saddle-back tooth instead of the facing, and while this style of construction possesses the advantage of presenting an occlusal surface of porcelain, and thus avoiding any display of gold, the more esthetic result is probably obtained at the expense of strength, as the thin lingual portion of such porcelain teeth is usually inherently weak and more or less easily broken. Where the stress of occlusion is light, however, they may often be used to good advantage.

Procedure. In their application a selection should be made which possesses as broad a neck as will be required to make a perfect joint with the cap, and which will restore the contact with adjacent teeth.

It should then be ground to meet these requirements, and to properly occlude and articulate, after which a single backing of about 34 gauge pure gold should be well adapted, attached by bending the pins, and trimmed to closely follow the edges of the porcelain without overhanging. (Fig. 142 A.)

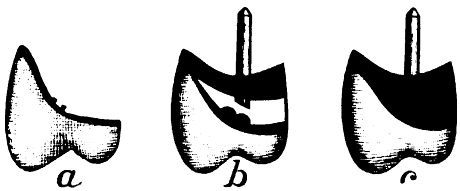


Fig. 142.

The proper relation to the cap should now be obtained (Fig. 142 B) and securely sustained with hard wax, and the crown invested in such manner as to have the porcelain covered, but to leave the backing freely exposed.

In soldering, a sufficient quantity of 18 karat solder (in addition to the use of balls of metal, if desirable), to afford ample and adequate contour of the approximal and lingual surfaces, should be used. Fig. 142 C illustrates the finished crown.

Use of Vulcanite Teeth. An ordinary vulcanite tooth may also be employed in similar manner, and in crowns of considerable length sometimes to even better advantage, because of possessing more strength in the lingual cusp, due to the greater body of porcelain surrounding the pins.

In their use the heads of the pins should be compressed between the beaks of pliers, or cut off, and the lingual surface ground smooth to facilitate the adaptation of the backing and the above procedure observed.

Application of Removable Crowns.

Previous to the modern methods of successfully treating chronic alveolar abscesses, the construction of crowns which could be temporarily removed from their attachment to the root and easily replaced was advocated and practiced as a means of permitting the necessary therapeutic treatment of roots so affected.

At the present time, however, such practice, for this purpose, has become almost, if not entirely, obsolete, and the application of such crowns is, in consequence, indicated only in the construction of *removable bridge-work;* hence, their indications and usefulness, together with the various methods of construction employed, will be subsequently considered.

Application to Irregularities.

Since some cases and forms of irregularities are not always amenable to the usual process of treatment for their correction, because of the age of the patient, the poor character of the teeth, their position in the arch, or other physiological or pathological reasons, it sometimes becomes warrantable to sacrifice the natural crowns and effect artificial substitution, which will relieve the disfigurement thus occasioned.

As the radical or injudicious destruction of the natural crowns of teeth must be regarded as presenting a serious aspect, and particularly when involving the anterior teeth, where they are necessarily sacrificed to the gingival line, a careful study of the existing conditions must be made, in order that it may be wisely determined that such a procedure is justifiable.

Indications.

The two general classes indicating such treatment as a means of improving both usefulness and cosmetic effect, are those resulting from *malposition,* and a diminution of the normal space caused by *gravitation.*

Malposition.

Cases are not uncommon wherein the malposition of one or more teeth, as previously indicated in Fig. 31, may be best corrected by the application of artificial crowns, but the achievement of successfully artistic and hygienic results in such instances will depend much upon a close observation of the necessary details of construction.

Construction.

In the construction of crowns for such extreme cases, as is illustrated in Fig. 143, the cap and dowel should be adapted to the root, as usual, and the bite and impression taken and models secured.

Extension for Support of Facing.

An extension from the cap which will afford a close adaptation to the tissue, and a practically unyielding support to the facing when placed in its proper position of alignment, should then be made by burnishing a piece of pure gold, 34 to 36 gauge, to the model.

When the desired shape and conformation have been obtained, the extension should then be *imbedded into* the model at least equal to its thickness by first marking the outline and then uniformly scraping the surface.

The cap should then be detached from the model and both cap and extension again placed in position and their relation sustained with hard wax.

The parts should now be removed and invested, and subsequently united with adequate re-enforcement. This can be best accomplished by trimming a piece of clasp metal or 22 karat plate, 28 to 30 gauge, of

Fig. 143.

proper size to rest upon the cap and cover the extension, and then uniting the whole with 20 karat solder.

This should then be replaced in position on the model, and the crown completed in the usual manner.

Hygienic Considerations.

The hygienic qualities possessed by crowns so constructed depend, of course, upon the adaptation of the extension and facing to the tissues upon which they rest; but the burnishing (or swaging, if more desirable) of the extension admits of a close conformation, and the scraping of the surface of the model beneath it and the neck of the facing so increases the bearing upon the tissue as to usually result in an adaptation of the finished crown which will preclude the lodgment and accumulation of debris.

Diminution of Normal Space.

A condition which is a phase of malposition caused by the natural tendency of teeth to gravitate toward an unoccupied space in the arch

is illustrated in Fig. 144, where, from the extensive destruction of the natural crown by caries, the adjacent teeth have moved together, until the space formerly existing in the normal relation is much reduced.

In such conditions, when involving any of the ten anterior teeth, the application of an artificial crown of *adequate and proportionate* size would be impossible, of course, unless sufficient accommodation be previously gained by *separating the teeth,* and such a procedure is indicated, and becomes essentially necessary, if the highest artistic results are to be obtained.

Separation of Teeth.

In separating the teeth in such instances the application of a simple regulating appliance may become necessary if any great deal of space is to be gained, and when the desired space has been obtained it may be preserved during the construction of the crown by wedging with a small piece of wood, or by *tightly* packing with gutta percha or temporary stopping during intervals between sittings.

Fig. 144.

Sufficient separation may often be secured in a more simple manner by trimming and closely fitting a wedge of soft wood, *previously compressed* in a small bench-vise, into the space. If the wood is properly trimmed to follow the outlines of the adjacent teeth, so that it may be worn with some degree of comfort, and then *tightly* fitted into the space, having the surfaces approximating the adjacent teeth slightly concaved to hold it in position, and the grain placed parallel with the long axis of the tooth, the absorption of moisture will usually produce an expansion sufficient to create the space desired. This may also be increased somewhat by the use of an intervening layer of cotton or tape when necessary.

Application of the Intradental Band.

For the purpose of avoiding the necessary peripheral preparation of the root and the possible irritating influence of a band, and at the same time securing the additional stability afforded by the latter to the attachment of a dowel crown, the *intradental* band has been devised.

The principle involved is similar to that of the original Büttner crown in which the *periphery* of the root was trephined so as to form a seat

for the accommodation of the band. In the application of the intradental band, however, a *groove* is trephined into the root midway between the pulp canal and the periphery, and a band subsequently fitted into the groove.

The design was probably originally suggested and patented by Dr. Moses Rynear, of New York, in 1886, but subsequent patents have been obtained on modifications of this by Dr. J. Leon Williams, of London, and Dr. B. J. Cigrand, of Chicago, in both of which the principle is the same, but the application and details differ somewhat.

While the advantages claimed by the advocates for this mode of construction are doubtless desirable, they are obtained at the expense of the integrity of the basal portion of the root, and for this reason are indicated only on large, strong roots, entirely free from decay, and will probably never become more generally applicable.

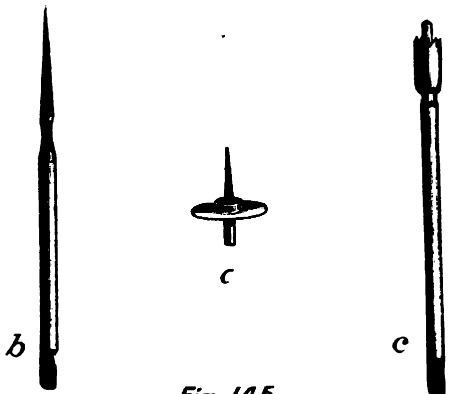


Fig. 145.

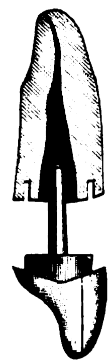


Fig. 146.

Williams's Method. The design and method devised and employed by Dr. Williams consists of a series of ready-made platinum caps and dowels in graded sizes, together with suitable trephines and root canal drills.

Application. In the application of this style of crown the root is prepared as usual for a dowel crown, without a band. A cap (Fig. 145 A) of suitable and proportionate size is then selected from the series, and the trephine and drill of corresponding size selected.

The canal is first enlarged with the drill (Fig. 145 B) to accommodate the dowel, and the trephine then used to cut the groove for the reception of the band, and the proper relation between the two is secured by the guide post in the center of the trephine. (Fig. 145 C.)

When the cap has been thus closely adapted to the canal and groove,

the surplus floor, which is about 34 to 36 gauge, should be trimmed to follow the peripheral outline, and burnished to the desired adaptation with the entire surface of the root.

The bite and impression should then be taken and the crown completed in the usual manner and mounted with cement.

The facility with which these ready-made caps may be secured and adapted to the root in the use of this method expedites the detail of construction, but the band seems too thin and narrow and the dowel too slender to afford adequate strength and stability to a crown of average requirements.

Cigrand's Method. The method devised by Dr. Cigrand constitutes making the band and cap and adjusting the dowel, and the necessary outfit consists of two sizes of trephines and a measurement gauge, as previously illustrated in a consideration of the treatment of *"fractured roots."*

Application. In the application of this method the root is prepared as indicated, and the groove cut as deep as practicable with the trephine of proportionate size. The band is then cut the exact length indicated by the measurement guide for the size trephine used, about one-eighth of an inch wide and of 30 gauge gold, 22 karat, or platinum, made in circular form, the edges abutted, and soldered with a very small bit of solder.

It should then be fitted over the end of the measurement mandrel to give it the proper form, and adjusted to position in the groove by gently forcing to place.

The surplus end extending from the root should be allowed to remain to facilitate removal and filed smooth on a parallel line with the surface of the root. It should then be removed and soldered to a floor of pure gold or platinum, 34 gauge, somewhat larger than necessary, with a minimum of solder.

The edge of the band previously fitted into the groove should now be trimmed away until the floor rests firmly against the root, when in position, after which it should be trimmed and burnished to the proper adaptation.

The canal should now be prepared, the dowel fitted, and then soldered to the cap, as indicated, and the crown completed in the usual manner.

The completed crown and the relation it should bear to the root in both of these methods is illustrated in Fig. 146.

Repairing and Removing.

Because of the presence of porcelain, and the consequent more or less frequent occurrence of fractured facings as a result of accident, in-

adequate protection, or faulty articulation and occlusion, as well as for the purpose of replacement or substitution, it often becomes necessary to repair this style of crown, or to remove it from its attachment to the root.

Repairing.

The presentation of fractured or broken facings on crowns and bridges constitutes a large per cent of the failures requiring such attention, and where the work remains otherwise in good condition, and is secure in its attachment, repair may be effected in an artistic manner by replacing the facings without removing the piece.

Replacement of Facings.

In the replacement of facings, several good and reliable methods are employed, but a selection of the best or most desirable one will depend much upon the construction of the work and the requirements of the case, as well as the individual preference of the operator.

When such a procedure is indicated, where the work has been constructed by the ordinary method, all remaining particles of porcelain surrounding the pins should first be broken and removed. This can be quite easily accomplished with excising forceps, cutting pliers or chisels, after which the projecting pins should be cut away and ground down flush and even with the surface of the backing, with a sharp, round, or oval, plain, or plug-finishing bur.

Usual Method.

The method usually and, perhaps, most commonly employed consists of securing the attachment of the replaced facing by simply bending or clinching the pins upon the lingual surface of the backing.

Procedure.

In this procedure a facing of the required size, shape and color should be selected, and the backing then properly perforated to admit of its adjustment.

The accurate position of the perforations may be easily ascertained, and designated, by first coating the surface of the backing with a *thin* film of melted wax, and then pressing the ends of the pins into it, after noting that they have been made *parallel with each other,* and that the facing is held in its proper relation to the backing and adjacent teeth or facings.

When the exact location has been thus, or otherwise, designated, the perforations may be made with a small spear-pointed drill, and subsequently enlarged to the proper proportions to receive the pins with a round or fissure bur, or twist drill, of corresponding diameter. While they should be large enough to readily admit of the reception of the pins,

the fit should be sufficiently close to render the attachment secure, and preclude the subsequent loosening of the facing.

The facing should be then adjusted to position and ground to fit the backing, and to meet the requirements of length, occlusion and alignment; and this may often be somewhat facilitated by bending the incisal or occlusal edge of the backing, with pliers, until a more favorable shape presents.

When the adaptation has been completed, it should be noted that the pins extend through upon the lingual surface sufficiently far to admit of securing a firm attachment by bending their surplus ends; and in the event of this being prevented by the thickness of the backing, its lingual surface should be previously ground down with small carborundum stones, or burs, until such security is made possible.

The surfaces of the facing and backing should then be thoroughly cleaned, slightly roughened and dried with alcohol or chloroform, when

Fig. 146.

the backing should be covered with cement mixed fairly stiff, and the facing adjusted to position, where it should be held *firmly* while the ends of the pins are being bent over upon the backing with pliers.

Moisture should then be excluded from the cement until it has thoroughly crystallized, when the edge of the backing should be finished down close to the porcelain, with disks, and the pins *flattened* with small stones until presenting a more or less smooth and continuous contact with the backing. The latter may usually be done to the best advantage, and with the least danger of fracturing the cement, at a subsequent sitting.

Brewer's Method.

The above procedure is much simplified and greatly facilitated by the use of a pair of *"riveting forceps,"* designed for the purpose of riveting the ends of the pins down close upon the backing, by Dr. Frank A. Brewer, Sr., of King City, Cal. (Fig. 147.)

One beak of these forceps presents a corrugated soft rubber pad, on an adjustable joint, which admits of its close adaptation to the facing at any angle or position, while the other presents a small concave steel point, also likewise adjustable, which engages the end of the pin.

Application. In the application of this method of attaching the facing, the perforations should be made and the facing adapted, as indicated, and then the ends of the pins or the backing should be sacrificed until the former project *only* about 1/32 of an inch beyond the surface of the latter.

The lingual surface of the perforations should now be somewhat countersunk with a round bur of proper size used in a right angle hand-piece.

When the facing has been well adapted, it should be placed in position with, or without, cement, and the forceps then adjusted, when a slight pressure upon the handles applied during a rotary or swinging movement of the arm will effect an expansion of the diameter, and a compression of the heads of the pins, until a very secure and finished attachment results, with little or no danger of fracturing the porcelain.

Underwood's and Mitchell's Method.

The method advocated by Dr. C. J. Underwood, of Elgin, Ill., which in similar detail has also been employed for a number of years by Dr. Wm. Mitchell, of London, England, is also valuable and useful, and is particularly applicable to those cases where the old backing was originally, or has been worn down until, too short to afford the proper protection to the porcelain along the incisal or occlusal edge.

This method consists of adapting a duplicate backing to the lingual surface of the old backing, and then attaching it to the pins of the facing with solder, and, wherever the occlusion will admit, its application may be made with very artistic results, and with a maximum of strnegth.

Application. In the procedure incident to the application of this method, the remaining porcelain and projecting ends of the pins should be removed from the old backing, and *slots* or *grooves* sufficiently wide to accommodate the pins of the new facing and extending from the incisal or occlusal end toward the cervical to a point which will admit of its proper adjustment, should be made with a cross-cut or plain fissure bur. (Fig. 148 A.)

The location of these grooves may be accurately designated, as previously indicated, and the bur used should be of a diameter as similar to that of the pins as possible.

The facing selected is then ground to the required and desired adaptation, and afterward backed up with pure gold, about 34 gauge. This

should be well adapted to the incisal or occlusal end of the facing, and trimmed to closely follow its outlines. The *cervical* edge of the backing should be then drawn away from its contact with the porcelain toward the extreme ends of the pins, so as to *straddle* or pass to the lingual surface of the old backing.

Facing and backing should be then adjusted to position on the crown or bridge, and the latter burnished to a close conformation with the lingual surface of the old backing, which, if too thick to allow the pins to project slightly through the new backing, should be ground until admitting of same. (Fig. 148 B.)

While it is best to secure this adaptation directly in the mouth, it may also be accomplished with reasonable accuracy by taking an impression of the crown and adjacent teeth, after the grooves have been cut, with gutta percha, and obtaining from it a *fusible metal* working model for the purpose.

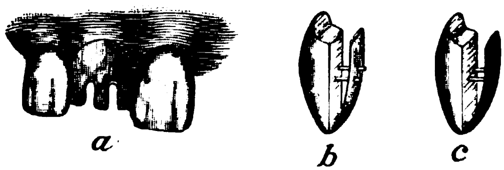


Fig. 148.

The adaptation should then be sustained by the use of wax or temporary stopping, and the facing and backing gently detached, and invested with sufficient care to insure the thorough penetration of the investment material into the intervening space between the two.

The relation should now be permanently sustained by soldering the backing to the exposed ends of the pins, and then re-enforcing it as much as the occlusion will admit, after which it should be finished and polished (Fig. 148 C.) and then mounted with cement.

While the detail of this method is necessarily somewhat circuitous, the procedure affords a most secure and finished result.

Dwight's Method.

Dwight's method, which has been previously mentioned and illustrated in connection with replaceable and detachable facings, is also applicable to the repair of work where the ordinary two-pin facing has been used.

Application.

When the remaining porcelain and projecting ends of the pins have been removed, a facing of this particular style should be selected and ground to place, in which the procedure is facilitated because of the absence of any pins.

After the proper adaptation has been secured, the "finder," which is included among the necessary instruments for doing this special work, and consists simply of a base or shank which fits into the socket in the facing, and tapers to a central point, should be adjusted to position. (Fig. 149 A.)

This affords a means of designating the exact location for a single perforation in the old backing, by applying sufficient pressure, or by the use of a thin film of wax, with the facing held in its proper relation.

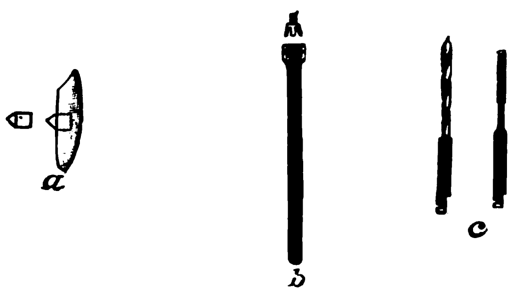


Fig. 149.

A *small* perforation should first be made at this point with a drill or round bur, and this then suitably enlarged with a twist drill, and subsequently threaded with a tap, both of which are also included in the outfit. (Fig. 149 B.)

The threaded shank of the "*attachment*" should be now adjusted to the "holder" (Fig. 149 C.), and screwed into place until its base rests firmly against the backing, and the spring ends are brought into proper position to engage the facing. If the latter is impossible at the first trial, the attachment should be unscrewed and removed, and the backing immediately surrounding the perforation ground away.

By this means the threaded area may be gradually diminished until the required relation is obtained, after securing which the projecting end of the attachment upon the lingual surface is ground down even with the backing, and the facing then mounted with cement.

Bryant's Method.

Among the most ingenious methods used in replacing facings is the one devised by Dr. Emory A. Bryant, of Washington, D. C. This consists of countersinking the old backing from the lingual surface; then threading the pins of the facing, and attaching it to the backing by means of a corresponding countersunk nut.

The latter are procurable in ready-made form, as are also the necessary instruments for doing the work, and while this method affords a secure means of attachment, the detail is somewhat exacting and requires considerable time.

It is perhaps more generally applicable to replacing facings on bicuspids, or even molars, in bridgework, than to the anterior teeth, because the strength of the attachment increases, of course, in proportion to the thickness of the backing, which in this particular region is necessarily governed by the occlusion, yet it may often be applied here.

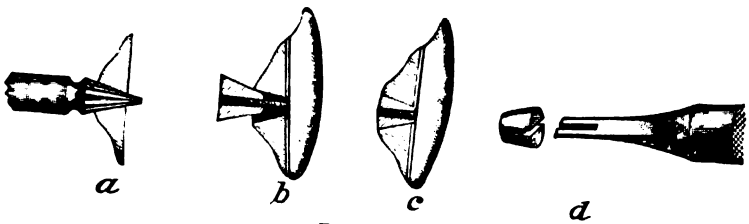


Fig. 150.

Application.

In the application of this method, the remaining porcelain, and projecting ends of the pins, should be removed, the new facing selected, and the backing accurately perforated for the reception of the pins, as previously indicated; after which the facing should be ground to the required adaptation.

The perforations in the backing are now countersunk from the lingual surface with the countersinking reamer in right angle handpiece, until they are suitably enlarged to receive the small end of the nut and admit of bringing it flush and even with the labial or buccal surface of the backing (Fig. 150 A.), *care being observed that it shall not protrude to the least extent.*

When this has been accomplished, the pins of the facing should be threaded, first with the large size tool, or screw-plate, and finally with the smaller one; in this procedure care must be exercised to prevent twisting off the pins. The use of a little oil will preclude this and facilitate the work.

The nuts are made of a well alloyed gold, corresponding in size with the reamer, and are *tapped* to fit the threaded pins of the facing, to each of which the respective nuts should be first adjusted to place, before the permanent attachment of the facing to the backing is made.

The backing should then be coated with cement, the facing placed in position and the nuts adjusted to the pins (Fig. 150 B) (which may be facilitated by a "holder"), and *alternately* screwed to place with the wrench, avoiding undue force, until both are firmly fixed in their proper relation and the attachment is secure.

The projecting ends of the nuts and pins should now be ground down, with small carborundum stones, until smooth and continuous with the backing, and the surface subsequently polished with disks. (Fig. 150 C.)

The nuts, and a wrench, suitable for their adjustment, are illustrated in Fig. 150 D.

Replacing Bicuspid or Molar Facings.

The replacement of facings on bicuspids and molars, although perhaps most generally confined to bridgework, will be also considered in this connection. This is usually a somewhat more difficult procedure, because of the increased thickness of the gold forming the cusps and lingual contour, and surrounding the area where the attachment must be secured, which usually precludes a projection of the ends of the pins.

Where it may not be desirable to employ the Bryant method, or where the same may seem contraindicated, or be impracticable, the most simple and commonly applied procedure is to cut a countersunk aperture in the old backing with drills and burs, of proportions sufficiently large to admit and accommodate both pins of an ordinary facing.

The facing should then be selected and ground to the required adaptation, and the ends of the pins bent somewhat diverging from each other, or to present short sharp right angle turns, which may be passed into the aperture when the facing is slightly inverted, and which will hook over its edge upon bringing the facing into proper position.

This will increase the integrity and strength of the subsequent attachment with cement, and the same may be further facilitated by serrating or roughening the surface of the backing with a sharp wheel or inverted cone bur.

Facing and backing should now be thoroughly dried, and the mounting made with cement mixed fairly thick, and with an observation of the previously mentioned details in this connection, reasonably permanent results may be obtained.

Where adequate mechanical retention is possible, plastic amalgam

may often be used to good advantage, and is sometimes preferable to cement.

Replacement of Facing and Backing. In those cases where the old backing has been almost, or entirely, destroyed, so that sufficient opportunity for securing adequate anchorage for a new facing, by any of these methods, is doubtful; or where the cap and dowel have become detached from the root, or may be removed without mutilation or destruction, repair can *almost invariably* be *best* effected by cutting the remaining backing off close to the base of the cap with a fine saw, excising forceps, carborundum stones or files, and attaching the facing and its new backing by *investing and soldering* in the usual manner.

The mechanical saw (Fig. 151) wi.. ·sually be found best adapted to such purpose, and is an indispensable device to a well-equiped laboratory.

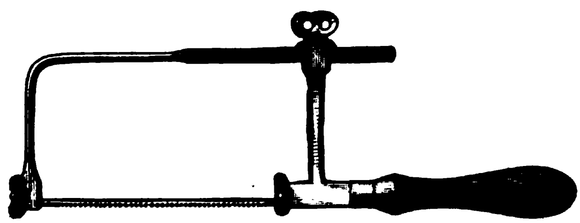


Fig. 151.

This procedure will afford opportunity for securing the strongest and most artistic results wherever the adaptation between cap and root is sufficiently good to warrant the use of the old cap, and where this is doubtful, a new crown should be constructed throughout.

Procedure. In such instances the procedure should consist in first removing the remaining cement from the interior of the cap, with burs, and then thoroughly cleansing in acid. The dowel should now be grasped firmly in a jeweler's pin-vise (Fig. 152) (which is a most useful instrument in this work), and the backing removed up sufficiently close to the base of the crown to offer no obstruction to the proper adjustment of the facing.

The cap should be then placed in position upon the root, and the usual "bite" and impression taken, when the repair can be made upon the models in accordance with the usual method of construction from this point on.

Removing.

The removal of this style of crown may often become necessary for the purpose of replacement or substitution, and while the procedure may be found somewhat difficult in those cases where the attachment remains secure, it may be effected by one or the other of the following methods:

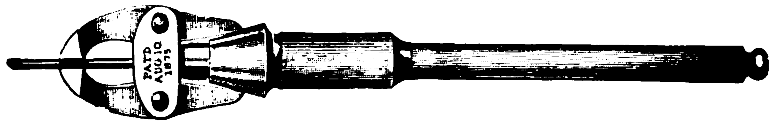


Fig. 152.

Use of Excising Forceps. The easiest and most convenient method, whenever applicable, is to first crush and remove the facing if present, and then grasp the remaining backing up close to the base of the crown, where it is thickest, with the beaks of a pair of excising forceps (Fig. 153) (which is also a most useful instrument), and then gradually and slowly fracture the cement and destroy the integrity of the attachment, by exerting a slight pressure upon the handles and a *lateral* or *rotary* movement upon the crown.

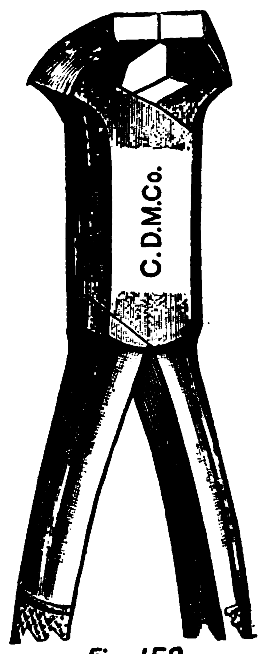


Fig. 153.

The power of the lever, in this application, will usually result in the ready detachment of the crown from the root, but force should be applied slowly and with exteeme care, in order to prevent injury to the peridental membrane, or the removal of the root.

In the event of *loosening* the root, because of its instability, or of the strength and integrity of the attachment of the crown, *which will always cause a slight gingival hemorrhage,* this procedure should be at once discontinued before injury has resulted, and another one requiring less force will be demanded.

Separating Cap and Dowel. When the above method seems contraindicated, or proves ineffective, or where the backing has been previously destroyed until no opportunity is afforded for its application, the removal may be facilitated and made easy and devoid of danger, by first separating the cap from the dowel.

This may be done by drilling through the base of the crown at a point *approximating* the *periphery* of the *dowel*, until the root has been reached, with a small drill or round bur, and then severing the cap from the dowel with burs of a larger size (Fig. 154).

When this has been accomplished, if it is desirable to utilize the cap again, it should be worked loose and lifted off with pliers; but if no further

Fig. 154.

use is to be made of it, the procedure may be facilitated by destroying the continuity of the band with excising or crown slitting forceps, or a small bur (Fig. 155).

The remaining dowel should then be removed by cutting away the surrounding cement with *very small* round burs, until it may be gripped with strong small-pointed pliers, and the entire length removed.

Fig. 155.

In this procedure, however, care must be exercised to avoid perforating the root, or breaking off the dowel at a point which will preclude the removal of the remaining end.

The use of the very ingenious instrument devised by Dr. C. G. Morrell for this purpose will be found very convenient, and it is particularly applicable to the removal of crowns or bridges when some effort to preserve the piece is desirable. (See Fig. 359.)

Another method, which has the advantage of leaving the dowel projecting to a considerable extent from the end of the root, is as follows: The porcelain facing being absent, or having been crushed and removed, a small drill hole is made in the cap, at the labial aspect, and

Fig. 156.

to one side of where the dowel is known to be attached. This perforation, sufficient to slightly disclose the cement, is easily made, after which the drill is changed for a small but sharp rose bur. With this bur a groove is cut incisally, and alongside of the dowel about two-thirds of the length of the backing. A similar drill hole and groove is then

Fig. 157.

cut on the other side of the dowel, and the two united across at the end (Fig. 156). With a little additional burring the cap and backing can then be removed, leaving the dowel with some of the original backing adhering to it, protruding from the end of the root (Fig. 157), thus affording considerable metal which may be grasped in the pliers. In Fig. 156

the backing is cut clear through, but in a thick backing this would not be necessary, much less cutting serving to release the dowel. The cement should be burred away as before indicated, but the removal of the dowel is much facilitated.

The Plate and Dowel Crown.

CHAPTER X.

Advantages. Indications, Requirements. Method of Construction; Typical Cases; Root Preparation; Six Anterior Teeth, Bicuspids. Adaptation of Plate, Adjustment of Dowel. Extensive Destruction of Root: Swaging Plate; Impression of Root, Dies, Dowels. Construction upon Models.

In view of the great variation of conditions presenting, and because of the possible objections to a band which may be made with reason and consistency in some instances, and in certain classes of cases; together with the advantages to be derived from a close and more or less perfect adaptation of the base of the crown to the end of the root, and the esthetic possibilities afforded—the plate and dowel crown differing from the preceding style by the *absence* of a band, and consisting simply of a plate and dowel base, has a wide range of application and usefulness, and is somewhat extensively employed in the restoration of the ten anterior teeth, and even sometimes on the molars.

Advantages.

When the employment of a band is contra-indicated, or seemingly undesirable, such a style of construction affords the advantage of securing a closer line of junction between the crown and the root, by *burnishing* or *swaging* a thin metal base and then adjusting a dowel and completing the crown in the usual manner, than could possibly result from grinding one surface to conform closely with another, such as becomes necessary in the application of the various forms of ready-made porcelain crowns.

While the esthetic possibilities thus afforded are also desirable, the principal features lie in the conservation of tooth structure, the preservation of the normal condition of the gingivae, and the degree of permanency that must result from obtaining a perfect joint between the crown and both the *base* and *periphery* of the root.

Indications.

This style of construction is especially indicated in two general classes of cases, and is applicable to a third, as follows:

First: In pathological conditions where any extensive preparation of the remaining root, such as would become necessary for a band, is precluded because of its instability, or because of the physical or nervous condition of the patient; or, where a recession of the gum from the normal gingival line would require the application of a crown without a band for esthetic reasons.

Second: Where the decay and destruction of the root is so extensive as to preclude the possibility of applying a band,—in which conditions, because of the extreme shortness and consequent close proximity of the end of the root to the border of the alveolus, no opportunity for securing an accurate adaptation of a band is afforded.

In this class of cases a crown may be constructed by swaging or burnishing a base to a close conformation with the surface and irregular edge of the root, with a degree of accuracy of adaptation, and support to the root which will offer a secure and reasonably permanent attachment.

Third: It is also quite generally applicable and more or less extensively employed in those typical cases where the root is sufficiently large and strong, and free from the evidences of caries or disintegration, as to probably require no support and protection, such as the application of a band affords.

Also, it is particularly applicable and perhaps most often the desirable procedure, in restoring the crowns of partially developed teeth in the mouths of *young* patients, because of thus avoiding any possible irritation to the more or less susceptible, sensitive and highly organized tissues in such cases.

Requirements. The requirements of construction constitute securing a preparation of the root, wherever sufficient tooth structure remains, which will mechanically prevent subsequent displacement of the crown, and of then securing adaptation of the base to both the *surface* and *periphery* of the root, which will afford a firm seating, and, in so far as possible, preclude a dissolution or disintegration of the cementing medium, or the subsequent occurrence of caries.

While a close observation and fulfillment of these requirements will doubtless make such a result possible, the degree of stability in the attachment will, of course, depend much, if not entirely, upon the dowel; which, because of thus assuming a preponderance of the stress imposed, must be properly adjusted to the canal, and of uniform and adequate rigidity.

Method of Construction.

As the method of construction for this style of crown differs only in the details incident to the preparation of the root, and the adaptation of the base, all reference to the application of the facing and the completion of the crown, whether for gold or porcelain work, will be purposely avoided, because the procedure from this point on is identical with that which is elsewhere considered in connection with each.

Typical Cases. In the application of this style of crown to typical cases, such as have been considered in the *first* and *third* classes of indications, and which will be confined mostly to the six anterior teeth, the first essential feature in the detail of construction is the proper preparation of the basal surface of the root.

Root Preparation. In this particular the requirements differ from those incident to the band and dowel crown, in that *no peripheral trimming is necessary,* and that the end of the root must be so shaped as to offer mechanical resistance to the stress imposed.

Six Anterior Teeth. In the six anterior teeth this may be accomplished by beveling the root both labially and lingually from a central point, so that the plate, which is to form the base of the crown, will straddle the exposed end, thus also overcoming any tendency toward a possible rotation or displacement of the crown.

The *labial* bevel should usually extend from the lingual edge of the pulp canal to a point sufficiently far beneath the gum to allow for the thickness of the plate, and thus admit of placing the neck of the facing in direct contact with the tissue, which adds to the esthetic effect by making the joint invisible.

The *lingual* bevel should not extend quite to the gum line, because of the absence of esthetic requirements upon this surface, and of the probable advantage in having the joint *exposed* to view to insure the accuracy of adaptation, and to the movements of the tongue and action of the secretions, to render it more hygienic or self-cleansing. (Fig. 158 a.)

This preparation may be easily accomplished with flat-edge carborundum stones, though the use of the root facer will facilitate cutting the root below the gum upon the labial surface. Wherever enamel is allowed to remain, however, and no band is employed, this instrument must be revolved slowly, and used with extreme care.

Bicuspids. While a similar preparation is usually desirable for first bicuspids, because they are also subjected to some lateral stress, it is not so essential to the

second bicuspids, for the reason that these teeth usually receive vertical stress mainly, hence a flat base, such as is indicated in Fig. 53, is all that is necessary, if the size and adjustment of the dowel is adequate.

Adaptation of Plate. When the desired preparation has been secured, a piece of pure gold, or platinum, as the requirements of the intended construction of the crown may indicate, about 34 to 36 gauge, should be cut a trifle larger than necessary, annealed, and burnished to a perfect adaptation with the surface of the root.

This is easily accomplished with flat and round burnishers, and the soft rubber tip of a lead pencil will also be found useful. While the thinness and softness of either pure gold or platinum will admit of securing the required adaptation by *burnishing*, the same may also be accomplished by a primary swaging, if preferable, though the latter method is more requisite in difficult cases, and will be subsequently considered.

a b c Fig. 158. d e

Adjustment of Dowel. After securing the proper adaptation of the plate, the canal should then be prepared for the reception of the dowel, and the latter fitted to it, when the plate should be replaced in position and the opening of the canal outlined in it with a round or oval burnisher. (Fig. 158 b.)

The plate should now be perforated with a sharp-pointed instrument or plate punch, and the dowel forced through the perforation until well into position. While the close fit thus secured between plate and dowel will usually sustain their relation while removing and soldering, if the same is doubtful, the usual means for sustaining it, as previously described, may be observed.

The two should now be permanently attached with solder and then again placed in position on the root and reburnished, when the surplus may be trimmed away and the plate reinforced to prevent a possible

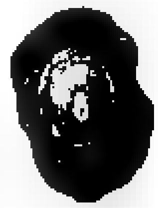
change of form while taking the impression, and subsequently detaching from the model. (Fig. 158 C.)

When the plate is of gold, this reinforcement should be made by flowing a thin layer of 20 karat solder over the surface and around the dowel, while if a platinum plate has been used, and a porcelain crown is to be made, twenty-five per cent platinum solder, or pure gold, may be employed.

The usual "bite" and impression should now be taken and models secured, when the facing should be selected and ground to a perfect joint with the labial and cervical aspect of the plate, if it is to be backed up and finished with gold (Fig. 158 d), and the crown then completed in the usual manner, and finished and mounted. (Fig. 158 e.)

Extensive Destruction of Root.

In that class of cases where the root has been more or less extensively destroyed from disintegration, or accident, and presents a concave sur-



a

Fig. 159.

b c

face and frail and irregular edges so deeply imbedded beneath the gum as to preclude the adaptation of a band, and yet possessing sufficient stability and integrity to afford a reasonably firm attachment for a well-adapted crown, as has been mentioned in the *second* class of indications, the first essential procedure incident to the construction of the crown is to tightly press away the surrounding soft tissue with temporary stopping, or gutta percha, until a *free exposure* of the end of the root is obtained.

While this may require two or three sittings, repeating the procedure at each, such time will be found to have been well expended, when it is desirable to make an effort to successfully crown such teeth, because of thus making possible and facilitating the accurate adaptation of the plate to the root, and the subsequent permanent attachment of the finished crown.

When the root has been thus freely exposed, the irregular edges should be ground down with small stones, or root facer, until as smooth

and even as possible; and all decay then removed, after which the remaining root should be thoroughly disinfected and sterilized, in order to arrest any further progress of caries.

The best means of obtaining the correct adaptation of the plate to the root will depend much upon the condition presenting, and while the required conformation may often be obtained by burnishing, a more certain, and perhaps increased, accuracy will not infrequently be secured by swaging.

Swaging Plate. To accomplish the swaging, whenever such procedure may be indicated, or seem desirable, an accurate and well-defined impression of the edge and surface of the root must be taken, and fusible alloy dies made therefrom.

Impression of Root. The use of pink base-plate gutta percha affords the most simple and accurate means of obtaining a well-defined impression of the end of the root.

In the procedure this should be cut into moderately small pieces and carefully and slowly warmed, on a mica slab over a flame, or on the electric annealer, until it is *plastic,* when a quantity sufficient to fill the space to be occupied by the crown should be tightly packed with burnishers over and against the end of the root, and in between the adjacent teeth, if any be present.

This should now be chilled with a spray of cold water, and removed (Fig. 159 a), and when sufficiently accurate, fusible alloy dies may be obtained from it.

Dies. To obtain the dies, the impression should be invested, with the imprint of the root downward, in a base of plaster of proportions sufficient to be subsequently trimmed to admit of the adjustment of the rubber casting ring (Fig. 159 b). When the plaster has become thoroughly crystallized, and has been thus trimmed, it should be placed over a small flame and allowed to heat slowly until the gutta percha may be removed (Fig. 159 c), when the rubber ring should be adjusted, and the die, and subsequently the counter-die, secured with fusible alloy. Or, the impression may be taken with hard modeling compound, the die made with quick-setting amalgam, and the swaging done in a swaging device.

Pure gold or pure platinum, as the requirements may inditate, of the thickness of about 36 gauge, should be now annealed, and swaged, after which it may be further adapted to the root by burnishing, as already indicated, and the dowel, or dowels, then adjusted and soldered.

Dowels The length and size of the canal, or canals, in such roots will indicate whether one or two dowels should be used, and as they are generally much

shorter than usual, and the major portion of the strength of the attachment will depend upon the dowel, it is essential that it should be of adequate size and length to *thoroughly fill the canal;* hence the use of two, whether they may be separate from each other, or in contact and subsequently united with solder, is frequently required.

The relation between the plate and dowel, or dowels, should be temporarily secured in the manner indicated, and then permanently sustained by soldering, and wherever two dowels are used, and particularly when they are separated, an investment should invariably be employed.

When they have been soldered, the cap should be placed upon the root and the edge of the plate readapted by burnishing, in which the use of a smooth foot plugger in the automatic mallet will often be found advantageous.

The usual "bite" and impression should be then taken and the crown completed as the requirements may indicate, as illustrated in Fig. 160.

While the interior of such roots is sometimes previously filled with cement or amalgam, and the plate then adapted to this surface by burnishing, the increased accuracy obtained by swaging it to closely follow the concaved surface of the root, and the additional support thus rendered to the latter with a minimum quantity of cement, adds materially to the integrity of the attachment between the two, when subsequently mounted.

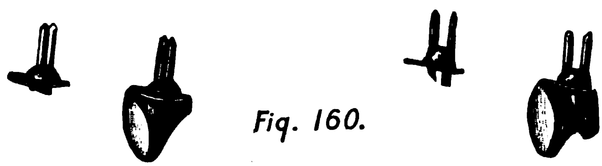


Fig. 160.

Construction Upon Models.

In instances where it may become necessary to construct the crown upon models, the most useful and accurate reproduction of the conditions may be secured by first fitting a wooden dowel into the canal and then packing gutta percha over and around it, until the impression of the end of the root has been obtained, as indicated.

When the desired degree of accuracy has been thus secured, it should be placed in position, and a plaster impression then taken over it. The removal of the latter will usually bring the gutta percha with it, but if not, it should be detached from the root and placed in its proper position in the impression.

When this has become thoroughly dry, the open ends may then be closed up with mouldine, and the impression filled with fusible alloy.

After separating from the plaster, and detaching the gutta percha and wooden dowel, this procedure will result in a metal model with a more or less perfect reproduction of the root and its canal, upon which opportunity is afforded for the construction of the crown in the manner indicated, and with reasonable accuracy.

[The application of this style of crown to the molar teeth is perhaps confined more especially to porcelain work, but the same general principles should be observed irrespective of the style of construction.]

Application of Dowel Crowns Without Plate or Band.

CHAPTER XI.

Advantages; Disadvantages; Indications; Requirements; Various Designs; Separable Dowels, Inseparable Dowels, Comparative Advantages. The Davis Crown: Application, Mounting, Repairing, With Band and Cap; Accuracy of Adaptation Without Band. The Logan Crown: Comparative Advantages and Disadvantages; Application; Mounting. With Band and Cap. Advantages; Procedure. Variation of Methods: Substituting Separate Dowel; Procedure. Increased Accuracy of Adaptation, Procedure. Porcelain Work. The Brewster Crown: Application. The "Fellowship" Crown: Separable Dowels. Repairing. Tube Crowns: Application; Procedure. Temporary Crowns: Indications; Procedure; Use of Amalgam; Use of Vulcanite.

The various styles of ready-made porcelain crowns which are designed to be adapted directly to the root, without the employment of a band or plate, and attached by means of a dowel, which may be either a separable or inseparable part of the crown, will, in regular sequence, be *designated* and *considered* under this classification.

While almost any of the several designs of this particular style of crown may be adapted with a band and cap, or even with a simple plate, they are thus classified because of being usually employed without such addition, and of being originally designed to be so adapted.

Although this particular style of crown preceded all others designed especially for the anterior teeth, they are still used somewhat extensively, and, irrespective of the improved means for obtaining greater *integrity* and *permanency*, they doubtless possess some intrinsic advantages, and still occupy a more or less limited sphere of *usefulness* and *serviceability*.

Advantages. Previous to the individual construction of porcelain-faced crowns, the application of porcelain work, and the present facilities for securing a more perfect adaptation to the root with equal opportunities for observing the esthetic requirements, as indicated in the preceding chapter, the advantages possessed by this style of crown were particularly desirable.

These constituted the ease with which the finished crown might be procured; the absence of the necessity for removing the enamel from

the periphery of the root; the *facility* and *dispatch* with which they might be adapted, and the *natural* and *translucent* appearance which the splendid forms and colors of some makes afforded.

While the latter is always an eminently desirable feature, particularly in the restoration of the six anterior teeth, and gives to all porcelain crowns of any similar design a distinctive advantage over those in which the translucency is destroyed by the presence of a backing, the former should be so considered in the application of crowns designed to serve as permanent reproductions, only when such are especially indicated, and as a means of expediency.

Disadvantages. The principal features which may be reasonably regarded as disadvantages, when such crowns are adapted without band or plate, lie in the difficulty of obtaining a crown of the same diameter as the root, and of securing a continuous and practically impervious joint between it and both the *base* and *periphery* of the root, together with the resultant absence of *preventive means* and *prophylactic* measures against the subsequent *dissolution* or *disintegration* of the cementing medium from the penetration of saliva, and the destruction of the root by caries or fracture.

As the result of a failure to observe the higher requirements in this connection, many roots have been lost from caries, or fracture, which might otherwise have possessed greater *integrity* and *usefulness;* and it is by no means uncommon to see such crowns so displaced from the stress of mastication, and the inherent weakness of the dowel, as to effect a disarrangement of the alignment, and afford a pocket between crown and root which serves as a receptacle for the accumulation of the products of decomposition.

Indications. In consequence of these possible disadvantages the application of such crowns without a band or plate, or without observing some means of securing a more *perfect* and *impervious* joint than can usually be obtained by grinding one surface to fit, and approximate with, another, is usually indicated only in those cases where *expediency* renders such choice absolutely necessary; or where, from the instability of the root, a recession of the gum tissue, or other pathological conditions, or for pecuniary reasons the application of a crown affording greater *stability in the attachment,* or *greater protection to the root,* may not seem warrantable.

And even in such instances their application should usually be confined to the six anterior teeth, because of the increased difficulty ordinarily encountered in adjusting them to the more or less *irregular shapes* and *uncertain canals* of the bicuspids and molars.

Conscientiously considered, such crowns must usually be regarded as *temporary work*, in view of the reasonable opportunities for securing greater permanency.

Requirements.

In the application of any of the various designs now used, the same esthetic requirements as indicated in the preceding chapter prevail, and the possible permanency of the crowns will naturally increase in proportion to the degree of accuracy obtained in adapting them to a close approximation with both the base and peripheral outline of the root; and much of the success attending such an adaptation will depend upon the proper root preparation.

Root Preparation. In the preparation of the root for the reception of such crowns, the removal of enamel, or peripheral preparation of any kind, becomes entirely *unnecessary*, of course, but the shape given to the basal surface should differ

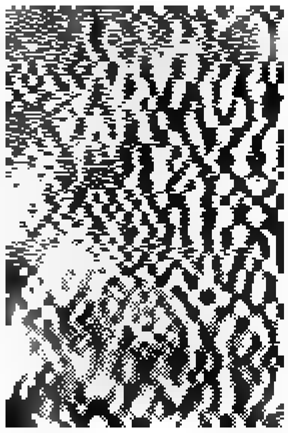


Fig. 161

from that indicated for the plate and dowel crown, because of the increased difficulty of securing an adaptation to such a shape, *by grinding*.

With the exception of the peripheral trimming, the preparation previously indicated in Fig. 50 will be found the most favorable to the requirements of the crown, and to the facility and accuracy with which the adaptation may be secured.

This consists in grinding the *labial* edge just beneath the gingival line, and in allowing the *lingual* to project slightly beyond it, with the basal surface assuming a smooth *inclined plane*. (Fig. 161.)

The former admits of the advantages considered in this connection in the preceding chapter, while the latter greatly facilitates the opportunities for securing the desired and required adaptation of the crown to the root.

Various Designs.

Although numerous designs of this style of crown have been presented from time to time, as previously recorded, only those which are now manufactured in good variety, and which are more or less extensively employed, will be considered. In their consideration it becomes necessary to divide them into two classes, because of the variation in their construction, and in the details incident to their respective application. Such variation mainly depends upon the possession of *separable* or *inseparable* dowels, and causes them to be classified accordingly.

Separable Dowels. The feature of this class of crowns embraces a separable or removable dowel, which may be previously mounted in the root, and to the projecting end of which the crown may be subsequently attached. They are designed for the purpose of facilitating the adaptation of the crown to the root, and include the principles first recognized by the Davis crown.

Inseparable Dowels. This class of crowns embraces the feature of an inseparable dowel, which is baked in or otherwise securely attached to, the porcelain, and forms an integral part of the crown, such as the original Logan, Brewster and "Fellowship" designs.

Comparative Advantages. While both of these styles, and all of these respective makes of crowns, are much used at the present time, and either is capable of being more or less readily adjusted to the root, a close study and analysis of the comparative advantages of the two classes must result in favor of those possessing a separable or removable dowel, providing, of course, that adequate means are afforded for the subsequent attachment of the crown.

This is apparent, for the reason that the opportunities for securing the closest possible adaptation, by grinding, are greatly facilitated by the temporary absence of the dowel, as its presence must necessarily afford some obstruction to this procedure, and at least increase the difficulties attending it, together with the liability of weakening the dowel, by grinding it, during the process.

The Davis Crown.

Of the several designs of crowns possessing separable dowels, the Davis crown, suggested by Dr. Chas. H. Davis, and manufactured by the Consolidated Dental Manufacturing Co., was the first one to be employed to any extent, or to be made in a sufficient variety of moulds and colors to meet the requirements, and it still enjoys quite an extensive application.

It is an all porcelain crown, having a slightly concaved base,

in the center of which is a depressed rim, which affords a rest for the shoulder on the dowel, and a countersunk cavity extending into the crown sufficiently deep to accommodate the projecting end of the dowel.

The dowel is proportionate with the size of the crown; slightly tapered; corrugated throughout its entire length to afford increased attachment to the cementing medium; has one flattened side to prevent the possibility of rotation, and a shoulder which adapts itself to the depressed rim for its accommodation in the crown, and is made of German silver alloy for the purpose of obtaining greater inherent strength and rigidity than is possessed by platinum. (Fig. 162.)

Application. When the proper selection has been made, the primary rough grinding may be done upon the model if the outline of the root is sufficiently accurate, but the final adjustment to the desired adaptation should be

Fiq.162.

a

Fiq.163.

made directly upon the root itself. This should be accomplished with carborundum stones in the engine, and when sufficiently accurate the ground surfaces, excepting the base, should be then nicely polished with disks.

The canal should now be prepared for the reception of the dowel, and the latter fitted closely to it; in some roots it may become necessary to shorten it somewhat from the apical end. When thus primarily fitted, it should be placed in position in the crown and temporarily sustained with wax until the two may be adjusted to position on the root. (Fig. 163, A.) This may necessitate a slight enlargement of the basal portion of the canal, or possibly the bending of the dowel, until the adjustment of the crown to its proper relation with the root is obtained, after which the crown and dowel may be permanently mounted. (Fig. 163, B.)

Mounting. In mounting, all particles of wax should be thoroughly removed from the crown and dowel, and the root rendered aseptic and dry, when the attachment of the latter to both crown and root may be made simultaneously with cement, or if it is preferable to use gutta percha, the dowel should be first fixed in the crown with cement, and attachment to the root made with gutta percha.

Repairing. One of the most important advantages possessed by this style of crown is the *ease and facility* with which repair may be effected in the event of subsequent fracture.

In such instances the dowel need not usually be disturbed, as its projecting end will afford ample opportunity for the retention of a new crown, after the removal of the remaining cement, and the necessary adaptation has been secured by grinding. These crowns may also often be found applicable and useful in the repair of the Logan, and other styles of crowns, where no backing is used, and the projecting end of the dowel remains sufficiently long to afford adequate *retention* and *resistance.*

With Band and Cap. When it may seem *desirable* to employ the band and cap, in the adaptation of this crown, and thus add to its possible *permanency* by supplying means for the *protection* of the root, it may be accomplished with ease.

In their application in conjunction with band and cap, the root should be prepared and the band fitted in *exact accordance* with the principles previously outlined in connection with the *band* and *dowel crown.*

When the band has been thus fitted and trimmed to the proper width, and the root ground down to evenly approximate its edge, as indicated in Fig. 125, B, the crown should be selected and ground to a close conformation with the basal surface of the root, as well as its peripheral outline.

The dowel should then be temporarily adjusted to the crown and fitted to the canal, until the crown may assume its proper relation. A plate of pure gold, 32 gauge, should now be perforated for the dowel, placed in position on the crown, and trimmed to follow its outline, with an allowance of about 1/32 of an inch surplus around the entire circumference.

After annealing this plate, it should be again placed in position on the crown, and both adjusted to the root, with the band in place. A degree of accuracy in the adaptation of the plate to the root, crown, and edge of the band may be obtained by placing a piece of soft wood against the end of the crown, and gently tapping it with a mallet, and then holding firmly and *burnishing the surplus edge* of the pure gold plate up tight against the band.

When this has been accomplished, the crown should be removed, and the pure gold plate placed in its proper relation to the band, which has been made possible by the burnishing of this surplus edge, and the two then united with 20 karat solder.

When the cap has been formed by the union of the band and plate, and the surplus and excess edge finished down smooth with stones and disks, it should be adjusted to position on the crown (to which the dowel still remains temporarily attached) and securely united with wax.

The interior of the cap should now be filled with investment material, or plaster, as indicated in Fig. 127, in order to securely sustain their relation while soldering. After this has become sufficiently hardened, the crown may be easily detached by slightly heating it over a flame until the wax melts, when the dowel should be united to the cap by filling in the space around the shoulder with 20 karat solder.

The cap may now be finished and polished, and then permanently attached to the root, when the crown may be placed in posi-

Fig. 164.

tion, and if too long, because of the thickness of the pure gold between it and the root, the incisal end should be ground until the length is correct and the crown then subsequently mounted with cement. (Fig. 164.)

While the floor may be attached to the band in the ordinary manner, without observing this detail, and the proper relation between the parts subsequently secured, tnis procedure is warrantable and preferable because of the accuracy and the conservation of tooth structure thus obtained, as otherwise the canal may need to be much enlarged to admit of placing the crown in its proper position and relation.

Accuracy of Adaptation Without Band.

A method of securing a preservation of the root, and a degree of accuracy in the adaptation of these crowns, without a band or cap, which seems quite practical and applicable to many cases, has been suggested by Dr. J. R. Owens, of Cleveland, Ohio.

In this method the basal end of the canal is enlarged as much as is consistent with the strength of the remaining edge of the root, and then somewhat countersunk. (Fig. 165, A.)

The crown is then adjusted to its proper adaptation by grinding, and the dowel subsequently fitted until admitting of the correct adjustment of the crown, when the dowel should be mounted in the constricted portion of the canal with cement.

The surplus cement flowing into the countersunk cavity should be removed and the latter then filled with amalgam. (Fig. 165, B.) While this remains plastic, the crown should be placed in position and gently forced to its proper adaptation with a piece of soft wood and small mallet. The excess amalgam is then trimmed away, until a smooth joint between crown and root remains, when the crown should be gently removed and afterward permanently attached with cement. (Fig. 165, C.)

The advantages claimed for this method are the protection afforded

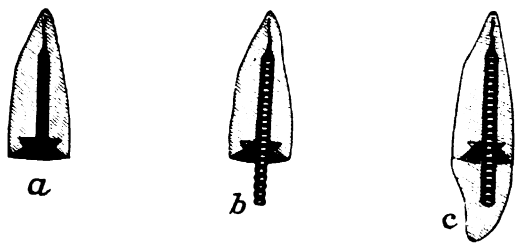


Fig. 165.

to the end of the root by the amalgam, and the accuracy of the adaptation between crown and root which is facilitated by its manipulation while in the plastic state. Its application, however, is necessarily confined to good, strong roots, and while the How "screw-post" is used by the advocate, as illustrated, the dowel of the Davis crown will doubtless answer as well.

The Logan Crown.

Of the various crowns with fixed, or inseparable dowels, the Logan crown, originally designed by Dr. M. L. Logan, and manufactured by the S. S. White Dental Mfg. Co., is, because of the almost unlimited variety of splendid forms and colors in which it is made, probably the most generally employed and universally adaptable.

The crown is made with a slight groove or depression in its base, immediately surrounding the dowel, thus forming an elevated rim around the edge which facilitates the adaptation, and, when not entirely

obliterated by grinding, affords increased strength to the attachment by admitting of the presence of a greater quantity of the mounting material.

The dowel is of platinum and is baked into the body of the crown. It is flattened and tapering in shape, and adjusted in the crown with the greatest diameter placed *labio* and *bucco-lingually*, or in line with the direction in which the greatest stress is usually imposed; and a slight corrugated depression in each side aids the attachment of the mounting material. (Fig. 166.)

Comparative Advantages and Disadvantages.

While this form of dowel is based upon theoretically scientific principles, objectionable features of some importance contra-indicate its too general application, and detract from its practicability. These constitute the possible weakening of small roots by the enlargement of their canals to the extent necessary to accommodate the greatest diameter of the dowel; the possibility of its bending under the application of stress in the line of its smallest diameter, and the inherent weakness of a *platinum* dowel which is further an-

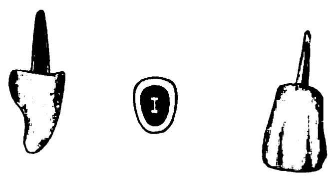


Fig. 166.

nealed to its softest form by being subjected to the high degree of heat necessary to fuse the porcelain.

In many cases this required destruction of the root may leave it so weakened as to be more or less easily fractured, if no band is employed, which is not an uncommon occurrence; and the lack of *rigidity* in the dowel, particularly in its lateral dimensions, affords opportunity for it to bend under stress in this direction, and thus admit of the displacement of the crown, which tendency or possibility may not always be overcome by the close approximation of the crown to the adjacent teeth.

In such cases, and especially where the latter is not possible, unless extreme care be taken, the employment of a crown possessing such a dowel may be contraindicated, and the application of one with a more round and rigid dowel may be found more serviceable.

Application.

In the application of the Logan crown the root should be prepared, a model secured, and the selection made in accordance with the previously mentioned requirements for this general style of crown.

A more accurate selection of the crown for the individual case may be greatly facilitated by preparing the canal after shaping the root, and then adjusting a temporary dowel of wood or metal, allowing it to pass well into the canal and to extend down to, or near, the incisal end of the adjacent teeth. (Fig. 167.) The end of an ordinary wooden tooth-pick will answer this purpose nicely, and when so adjusted, a modeling

Fig. 167.

compound impression should be taken with it in position.

In removing the impression, the temporary dowel should remain firmly embedded in it, or be subsequently so placed, and the model made.

The removal of the dowel from the model will leave an outline of the canal, and indicate its size, and position, in relation to the root, all of which will be found decidedly convenient in, and advantageous to, the selection of the crown, because of the facility with which it may be readily adjusted to place. (Fig. 168.)

Fig. 168.

While the final adaptation of the crown should always be made directly upon the root, the above procedure will be found additionally advantageous if the impression is taken in plaster, and, after drying thoroughly, then filled with fusible alloy. This affords an accurate and comparatively indestructible model containing the outline of the base of the root, and a reproduction of the canal; and the crown may be selected,

and primarily ground to a fairly accurate adjustment upon it, during the absence of the patient.

The grinding to the proper adaptation should be accomplished with small flat-edge carborundum stones, in the engine, and care must be observed to avoid cutting into the dowel, or weakening its attachment to the porcelain. (Fig. 169.) The use of curved stones, suggested by

Fig. 169.

Mr. Robert Brewster, will be subsequently mentioned (Page 214) and may be found useful.

In the final adaptation of the crown, the use of small disks of carbon paper, perforated so as to slip over the dowel and rest against the base, with the carbon side placed next to the porcelain, will be found serviceable in securing a close approximation. (Fig. 170.)

In the use of such disks, as the crown is pressed to place, the points of contact between it and the root will be designated by a black mark

Fig. 170.

on the porcelain, and the grinding at such points should be continued until the entire base thus indicates a uniform contact.

The requirements of peripheral approximation and occlusion should now be observed with care not to destroy the integrity between crown and dowel, and when the adaptation has been completed, any surfaces of the porcelain which have been ground, excepting the base, should be nicely smoothed and polished with disks, and the crown then mounted.

Mounting. While many methods of mounting this style of crown are advocated, and the subject in general will receive subsequent consideration, the permanency of the attachment by any method will, of course, depend much upon the accuracy of the adaptation. Where the joint is close enough to be rendered practically impervious, either cement or gutta percha may be used, as is the practice, and at the discretion of the operator.

The indications for the use of gutta percha increase, however, in proportion to the inaccuracy of the adaptation, and the two materials may be combined to advantage if desirable. In this procedure a disk of the ordinary pink base-plate gutta percha should be cut a trifle larger than the base of the crown, and then perforated to slip over the dowel. The latter should now be slightly roughened with a sharp instrument, and both it and the base of the crown then moistened with oil of cajaput or any solvent, and the gutta percha disk adjusted to position.

It should then be placed on the electric gold annealer, or on a mica slab, over a flame, and slowly heated until the gutta percha becomes plastic, when, after moistening the root with water to prevent adhesion, the crown may be forced to place with enough pressure to mould the gutta percha to it, and to the root, and to fill the intervening space.

While the crown is now held firmly in place, the surplus should be trimmed away around the joint with a sharp, warm instrument, after which it should be removed and again placed upon the heating apparatus, until the root has been dried, and the base then moistened with the solvent, when it may be mounted with cement in the ordinary manner.

A similar procedure is indicated in the use of gutta percha alone.

With Band and Cap.

Several methods of employing the Logan crown in combination with a band and cap have been suggested as a means of obtaining greater permanency in their application; and when so adapted this or almost any of the various forms of such crowns possesses advantages which place them next in rank to porcelain work.

Advantages. Such advantages constitute not only the increased integrity of the attachment, and preservation of the root, but include the esthetic possibilities which may be obtained in the translucent and natural appearance afforded by an all porcelain crown devoid of the presence of any backing.

Procedure. Of the several methods advocated for so adapting this style of crown, a modification of the one devised by Dr. J. G. Hollingsworth will be found to be the most generally applicable and universally practicable.

This consists in preparing the root as previously indicated in connection with the *"band and dowel" crown* and the *Davis crown with a band,* and in fitting the band and constructing the finished cap *in the same manner as prescribed for the former.*

The crown should be selected in accordance with the details indicated, and this may be observed either before or after the adjustment of the cap. In grinding it to the proper adaptation, however, the cap should be laid aside, and the adjustment made directly to the root, in which procedure *the original form of the base of the crown is entirely changed,* and it is only necessary to observe accuracy along the labial edge. (Fig. 171, A.)

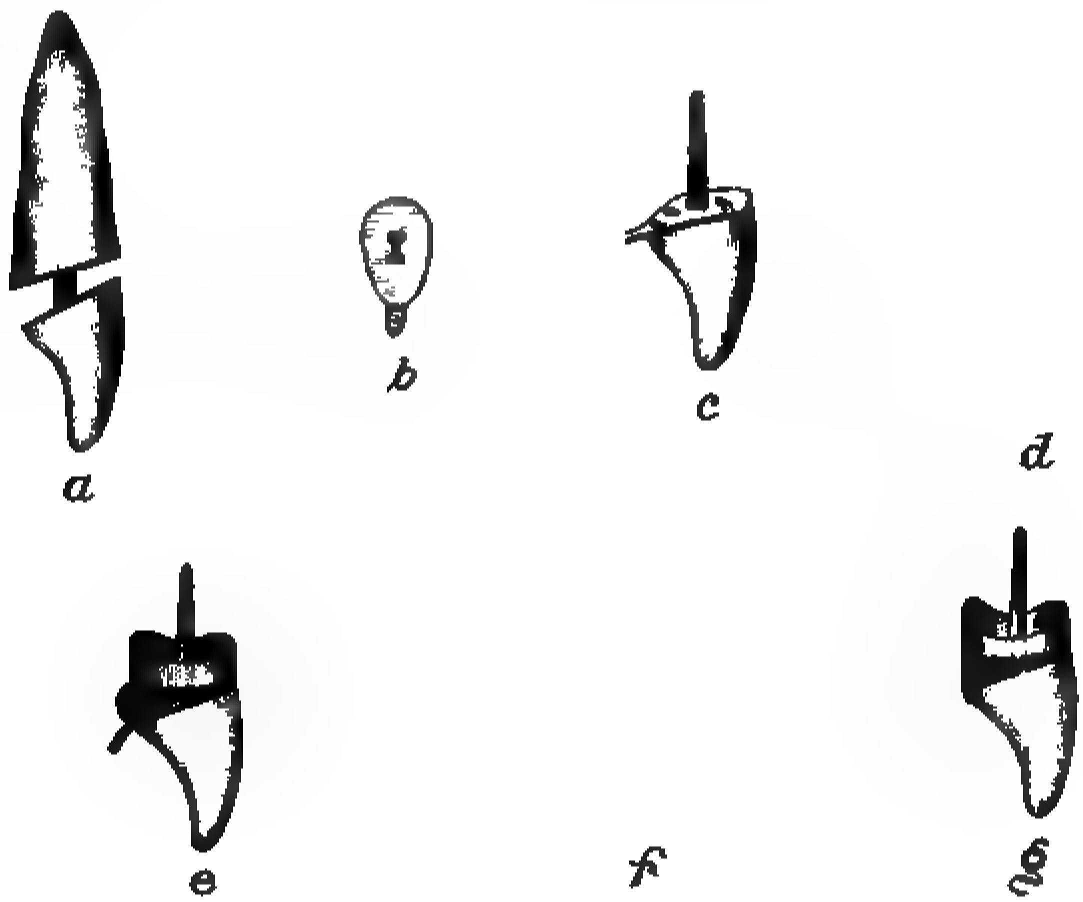


Fig. 171.

When a moderately accurate adaptation of this surface has been secured, together with an observation of the remaining requirements, the cap should be placed in position on the root, perforated to receive the dowel, and the *final adjustment then made with it in place.*

When the required adaptation has been thus obtained, the base of the crown should be further ground away on the *lingual* and *approximal* edges until an adequate V-shaped space exists between this portion of it and the cap. The space should be large enough to admit of being subsequently filled with solder, by which means the crown and cap are permanently attached, but should be no larger than necessary to facilitate

this procedure, because of the possible weakening of the attachment of the dowel in the porcelain.

The perforation of the cap should be made with care to have the dowel *fit* closely into it, as a preservation of the accurate relation between crown and cap, and the facility with which a strong union between them may be effected, will depend much upon such a relation. In the event of making too large a perforation, an additional disk of thin gold or platinum may be more accurately adjusted to the dowel, burnished to place on the cap, and separately soldered in its proper position, thus overcoming any possible difficulties in this connection.

The crown should now be backed up with a disk of *platinum,* about 36 gauge, which should be properly perforated, annealed, and closely burnished to place. In trimming it to follow the outlines of the base of the crown, a slight *lingual* extension (Fig. 171, B) should be allowed to remain, for the purpose of engaging in the investment material, and thus retaining the backing in close proximity with the porcelain during the process of soldering If this precaution is not observed, the backing will invariably be drawn away from the base of the crown, as a result of the shrinkage of the solder, thus diminishing the strength of the union, and affording an unhygienic joint.

A backing of pure gold might also be used instead of platinum, but the extreme thinness necessary to admit of carrying the porcelain well up to the gingival line would only introduce the possibility of fusing it during the process of filling this small space with solder.

When the backing has been adjusted, it should be attached in position on the crown with melted adhesive wax (Fig. 171, C), and the relation between crown and cap then secured on the root (Fig. 171, D), with the same material. To accomplish this with accuracy and facility, the cap should be placed in position on the root, kept perfectly dry, a little adhesive wax melted on the backing around the dowel, and the crown then quickly carried to place in its relation to the cap.

If the adhesive properties of the wax are not destroyed by the presence of moisture, and it is sufficiently heated to admit of the proper adjustment of the crown, the relation will be securely sustained, and crown and cap may be safely detached from the root with a small pointed excavator passed around the edge of the band.

The remaining space in the joint should then be completely filled with wax (Fig. 171, E), and the crown invested. Previous to investing, the lingual extension of the backing should be bent over *toward* the porcelain *without overlapping* upon it, until it may be so engaged in the investment material as to be held in place, yet offering no impediment to the soldering.

When the investment has crystallized, it should be trimmed down until as small as possible, to possess sufficient strength to hold the parts together. The wax should now be removed, and the joint between cap and backing then *freely exposed,* so as to admit of, and facilitate being filled flush with solder (Fig. 171, F.) The case should now be fluxed, heated thoroughly, and the space then filled with 18 karat solder.

In soldering such crowns, it must be remembered that the porcelain contains a large mass of platinum, hence it becomes necessary to first heat the porcelain well, in order to prevent the occurrence of a fracture.

In filling the joint, the solder should be cut in small pieces, and each one of these *consecutively applied and fused,* to assure its penetration to the full depth; and a *secure attachment to the dowel,* which, being covered with investment material, and being most remote from the exposed surfaces, is in consequence the most difficult to heat thoroughly.

This occasionally accounts for a failure to unite the crown to the cap, and in the event of such an accident their union may be subsequently effected by again investing, leaving only the *interior of the cap and the dowel exposed,* and attaching with a minimum of solder at the point of junction between the two.

The contouring of the solder to a flush smooth surface may be somewhat facilitated by cutting small triangular pieces of platinum or gold foil, or *thin* plate, and adapting them to the approximal sides of the wax in the joint, *before investing,* thus forming a matrix for the solder.

When the soldering has been completed and the cap becomes an integral part of the crown, it should be finished and polished as usual (Fig. 171, G), and then mounted.

Variation of Methods.

Several other methods of securing additional stability in the application of such crowns are employed, and at least two of them may often be used to advantage. These consist in *excising the original dowel* and replacing it with a *separate* one; and in *burnishing or swaging a thin plate to the basal end of the root* and attaching it to the crown and dowel, as a means of securing a more perfect adaptation without the use of a band.

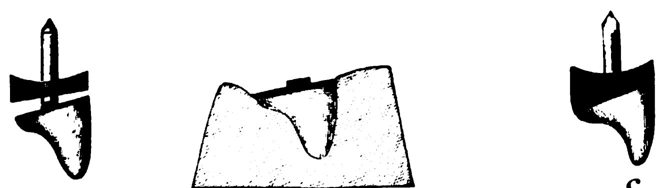
Substituting Separate Dowels.

Cases not infrequently present where it may be difficult to secure a proper adjustment of a *fixed-dowel* crown, because of the constricted size, or unfavorable location of the canal; or the position or shape of the root. In such instances the accomplishment of good results with the use of this style of crown may occasionally indicate, or even

necessitate, the excision of the original dowel, and the employment of a separate one.

Procedure. When this procedure seems required, the cap should be constructed as usual, and an ordinary platino-iridium dowel fitted to the canal and soldered to it, allowing but a *short* projecting end to extend beyond the floor and toward the porcelain, so as to offer no, *or a minimum,* obstruction to the subsequent adjustment of the crown.

A suitable crown should be then selected and its dowel cut off at a point about 1/16 of an inch from the base, when it may be ground to the proper adaptation, as further indicated in the preceding method. It should then be backed up in a similar manner, excepting that the backing may be trimmed to follow the entire outline of the base of the crown, and separately invested, so as to afford a *full exposure* of the surface of the backing (Fig. 172, A). When properly heated, this may be securely attached to the short projecting end of the dowel with solder.



b a c

Fig. 172.

The proper relation of the crown to the cap (Fig. 172, B) may now be secured and sustained with adhesive wax, and the parts removed, invested and soldered, as indicated. The finished crown is illustrated in Fig. 172, C.

As the degree of strength obtained in the union of the crown with the cap and dowel will depend much upon the length of the projecting end of each dowel, and naturally increase in proportion thereto, this procedure should be confined to extreme cases, or to those wherein the length of the crown may admit of a sufficient exposure of the ends of the dowels to insure a degree of integrity in the finished crown.

Increased Accuracy of Adaptation. A method of securing increased accuracy in the adaptation of the crown to the root, which is applicable in many instances where it is not desirable to employ a band, was perhaps originally suggested by Dr. Gordon White, of Nashville, Tenn.

This consists in shaping the root, adapting the crown, and changing its original form, as previously described.

Procedure. In the procedure incident to the employment of this method, a disk of platinum foil, about No. 40 or 50, is annealed, perforated for the dowel, and burnished to a close adaptation to the base of the crown, after the latter has been properly ground, as indicated (Fig. 173, A). A second disk is then cut somewhat larger than necessary, to cover the end of the root, and closely adapted to it, thus forming a V-shaped space between the two surfaces of metal which is subsequently filled with solder, in the manner previously outlined. (Fig. 173, B.)

The first disk, which forms a backing for the crown, should have a slight lingual extension for the purpose of sustaining its close proximity with the porcelain while soldering; and the second disk, which is adapted to the base of the root, should possess a slight surplus on the

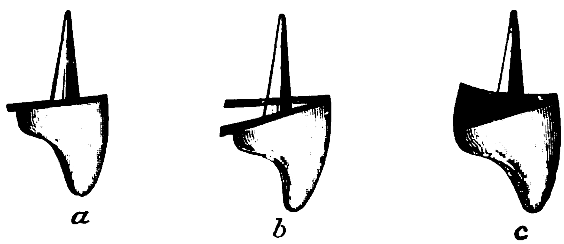


Fig. 173.

lingual surface, which may be slit and burnished up over this portion of the root, thus resulting in the additional support of a partial band.

In securing a proper and close adaptation of each to their respective positions, the first disk should be placed in position on the crown, burnished, and trimmed, and then attached to the dowel with adhesive wax. A sufficient quantity of the latter to a little more than fill the space between crown and root should then be placed over this, and the second disk adjusted to position on the wax and attached by touching it with a hot instrument. The wax should then be chilled with cold water, the crown and disks placed in position on the root, and force enough applied with a piece of wood and small mallet to carry it well to place, which will *swage* the second disk to a close conformation with the base of the root, if enough wax is present.

The whole should then be removed and the surplus wax trimmed down flush with the crown. The second disk may now be trimmed to closely follow the outline of the root, excepting upon the lingual, which

portion may be slit, as suggested, and burnished up over this surface of the root upon the replacement of the crown. (Fig. 174.)

When this has been accomplished, it should be removed, and invested, and soldered, with an observation of the previously mentioned requirements and precautions in this connection, and the finished crown is illustrated in Fig. 173, C.

In roots possessing an irregular outline or concave base, this, or a similar, procedure may be found advantageous; and the disk which is to be adapted to the root may be made of a heavier gauge of platinum when indicated, or desirable, in the manner previously recommended in connection with the "*plate and dowel crown.*"

Porcelain Work.

This procedure is also equally applicable to porcelain work, and when porcelain is preferable to the use of gold solder, for uniting the plate to the crown, the details differ only in dispensing with the *first* disk, as this

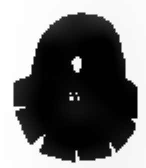


Fig. 174.

is used simply as a backing for the crown, and no backing becomes necessary in porcelain work.

The adaptation of the disk to the base of the root, and the manner of obtaining and sustaining its relation to both the crown and root, may be accomplished as indicated, but the case should then be invested and the disk permanently attached to the dowel with pure gold, or twenty-five per cent platinum solder, before filling the intervening space with porcelain, as a means of precluding any possible change of relation which may accrue as a result of the shrinkage of the porcelain body in fusing.

The Brewster Crown.

Among the several other varieties of porcelain crown possessing fixed dowels, the Brewster crown, designed and manufactured by Mr. Robert Brewster, of Chicago, Ill., is more or less extensively employed.

It is made of porcelain body, quite similar to Ash's English teeth, in a good selection of moulds and colors, with a slightly concave base,

and a *round* dowel. The latter is made of a composition metal similar to the alloy of German silver, and is attached to the crown with a low-fusing body. This enables it to possess the advantage of strength and rigidity, as well as economy, and yet the attachment between crown and dowel seems quite secure (Fig. 175, A).

Application. The application of this crown may be made whenever the employment of a fixed dowel crown is indicated, or desirable; either with or without a band or plate; and the detail of procedure, in each instance, is identical with that indicated for the Logan crown, excepting that the composition of the dowel and its manner of attachment in the porcelain preclude its use in connection with porcelain work, where it is necessarily subjected to a high degree of heat in the furnace; though the same readily admits of the use of 20 karat solder.

The favorable shape of both crown and dowel, and the comparative ease with which it may be procured and adjusted, combined with its

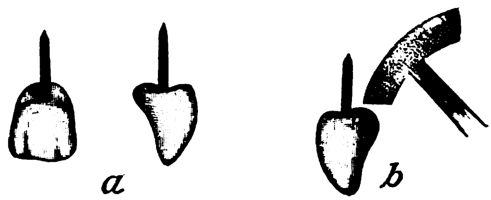


Fig. 175.

inexpensiveness, make it very useful for *temporary* purposes; but when employed as a permanent crown the dowel should be slightly flattened on at least one side (or serrated), in order to facilitate the attachment of the cementing medium, and thus prevent possible rotation or loosening.

The adaptation of the base of the crown to the root may be accomplished with greater facility, and less danger of grinding the dowel, by the use of *curved* carborundum wheels, which are designed and recommended by Mr. Brewster for this purpose. (Fig. 175, B.)

The "Fellowship" Crown.

The "Fellowship" crown, devised and manufactured by the Dental Protective Supply Co., is constructed along lines similar to the preceding crown, and is also more or less extensively employed.

Any possible rotation of the crown on the dowel, or in its attachment to the root, is prevented by the shape of the dowel, and the manner in which it is attached to the porcelain. The shape, however, is similar tó that of the dowel of the Logan crown, and in consequence possesses

the same objectionable features. It is made of a German-silver alloy, and is attached in the crown by means of an additional piece of wire passing laterally through perforations in the base of the crown and end of the dowel, which are then subsequently filled flush with low-fusing body. (Fig. 176.)

Separable Dowels.

As an indication of the recognition of the advantages of a separable dowel, all of the ready-made crowns originally made with *fixed* dowels—except the last mentioned—are now made with separable dowels.

Repairing.

In the event of the subsequent occurrence of a fracture of the porcelain in any of the various forms of fixed-dowel crowns, the method of repair is often difficult and sometimes even impossible; and the best

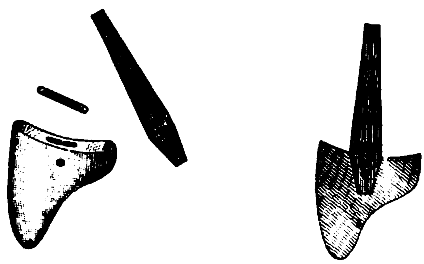


Fig. 176.

results are usually accomplished by removing the remaining dowel and adapting a new crown.

When it has been mounted with cement, however, and particularly in small constricted roots, this is often a difficult and sometimes dangerous procedure; but may be accomplished by drilling out the cement immediately surrounding the dowel with a very small round bur until it may be gradually loosened and removed, in which extreme care must be exercised to prevent perforating the root or breaking off the dowel at a point which will likely preclude the removal of its apical end.

In very small roots or where either of the latter results seem at all probable, the method suggested by Dr. Joseph Head, of Philadelphia, may be employed to advantage. This consists in cutting the dowel into two lateral halves by drilling vertically through its smallest diameter with a small round bur, and when so divided, the space thus produced will admit of loosening each half until their separate removal may be effected without danger of weakening the root. A pair of forceps designed especially for this purpose by H. N. Lancaster may also be found very useful.

In those cases where the dowel remains firm in its attachment to the root, and the length and strength of its projecting end will afford adequate means of sustaining a new porcelain crown, it may often be left in place and a Davis crown adapted to the root and then cemented to it; or, a crown may be *constructed* possessing a *socket* in its base which will fit and engage the projecting end of the dowel and securely sustain it in its proper relation, when mounted with cement. As this latter procedure involves the construction of a crown which may often be found useful and practical it will be separately considered under the classification of *tube crowns.*

Tube Crowns.

This style of crown is adaptable to that class of cases previously referred to wherein the original has been broken away leaving the dowel still firm in its attachment to the root; and may be employed as a means of substituting a well adapted crown when, for any reason, it may not be deemed advisable, or desirable, to remove the remaining dowel.

The application of such a procedure and of the principles involved was probably first suggested by Dr. Wm. Mitchell, of London, England, but is also advocated and employed, as applied particularly to porcelain work, by Dr. Jas. E. Keefe, of Chicago, Ill., and Dr. F. J. Capon, of Toronto, Canada.

Application. While the application of such crowns is necessarily confined to repair work, they are equally applicable to cases where the original crown possessed a band and cap, which may or may not remain securely in place, as well as to those where no band was used, so long as the dowel itself remains; but the strength in the attachment of the new crown will of course depend upon the length of the end of the dowel exposed and projecting beyond the surface of the cap, or root, which may be telescoped by the tube.

When this is inadequate the opportunities for securing sufficient integrity may be increased by drilling out the cement around the dowel, and thus trephining its end, with a small round bur, until a greater length is exposed; but where a cap remains, unless the dowel projects sufficiently far beyond it, such access and possibilities may indicate its destruction and removal.

When the dowel has been thus exposed so as to insure sufficient stability in the attachment of the crown, its end should be squared up and properly shaped to admit of, and facilitate, the adaptation and *easy removal* of a telescoping tube. (Fig. 177, A.)

Procedure. This tube should be made of pure gold or platinum, about 36 gauge, and may be formed on a piece of wire previously selected for the purpose, and a trifle larger in diameter than the dowel; or *foil* may be used and adapted directly to the dowel, if subsequently reinforced with solder; which should be also observed even in the former.

When made and fitted, the joint should be soldered, and the tube then adjusted to the dowel. A disk of pure gold or platinum, as the requirements of the intended construction may indicate, about 36 gauge, should now be perforated to fit closely over the tube, burnished to a close adaptation to the root, and trimmed to follow its peripheral outline. The surplus end of the tube should now be cut off even with the end of the dowel, and the proper relation between it and the disk securely sustained with adhesive wax, when they may be detached from the root and invested and soldered, at which time the open end of the tube presenting

a b c

Fig. 177. d

toward the incisal edge should be closed. This affords an accurately adapted base for the subsequent construction of a crown in the ordinary manner, using a facing in combination with either gold or porcelain, which may then be finished and mounted with cement.

The completed crown for that class of cases where the end of the dowel projects far enough beyond the base of the root to afford adequate stability in the attachment is illustrated in Fig. 177, B; while the construction for those cases wherein the end of the dowel is trephined and the tube thus extended into the root, as a means of securing greater integrity, is illustrated in Fig. 177, C, and the relation of the finished crown to the root and dowel in the *former* class is illustrated in Fig. 177, D.

Temporary Crowns.

The employment of temporary crowns become necessary in *emergency* cases where *immediate* substitution of the lost natural, or broken artificial, crown is required; and is indicated in the construction of per-

manent crowns *for the anterior teeth,* for the purpose of relieving the patient of temporary disfigurement and embarassment during the procedure. Their use also materially facilitates the subsequent adjustment and mounting of the permanent crown by keeping the gum packed away and preserving a free exposure of the end of the root, during the interim.

Fig. 178.

Indications. In view of the possible advantages thus derived from their use in the application of dowel crowns, and particularly in the mouths of women, they should be invariably employed whenever the time required to complete the construction of a permanent crown precludes finishing and mounting the latter on the same day on which the root is prepared.

While almost any of the fixed-dowel crowns, and especially the less expensive ones, will often answer this purpose, and even the old-style English tube-teeth may be employed, the most simple, expeditious and inexpensive method consists in using an ordinary long-pin facing, and constructing the crown for the individual case.

Fig. 179.

Procedure. To facilitate the application, at least a small selection of facings for the six anterior teeth should be kept on hand. One suitable to the requirements of the case in size, shape and color, should then be selected and ground to a fairly good adaptation, and a dowel then made of German-silver wire. Such wire is convenient for many purposes and may be easily procured in six-inch lengths of various sizes from jewelers' supply houses. Fig. 178.

A proper length and size of dowel should be cut, one end slightly tapered with a file, and the other flattened with a small hammer on the anvil, Fig. 179, or by pressing between rollers, Fig. 180, both of which are useful appurtenances for the well equipped laboratory, until it is broad enough to fit in snugly between the pins. This is done for the purpose of facilitating the attachment of the facing, and preventing any obstruction to the occlusion, but should not be done with a file, because of thus unnecessarily diminishing the strength of the dowel at this point.

The most convenient method of attaching the facing and dowel has been suggested by Dr. W. H. Taggart, of Chicago, Ill. In this pro-

Fig. 180.

cedure the flattened end of the dowel is made somewhat broader than the space between the pins of the facing, and then *notched* with the edge of a file until it may be slipped into place, with the pins fitting closely into the notches. The permanent relation between the two may then be securely sustained by bending the pins over upon the dowel.

The dowel should now be bent, if necessary, until the crown may be properly adjusted to position on the root, when it should be mounted with temporary stopping or gutta percha, with which the desired contouring of the lingual surface can also be made. The consecutive steps of this entire procedure are illustrated in Fig. 181.

Temporary stopping may be used with greater facility and possesses sufficient integrity to serve the purpose for a few days, but when the crown is to be worn for a longer, or more indefinite period, gutta percha should be used.

Although the detail incident to the construction of such crowns consumes but five or ten minutes' time, an assortment of these dowels may be made at convenient opportunities, and kept for subsequent use, which will further expedite the work.

The relation between facing and dowel may be also sustained by the use of either *hard* or *soft* solder, if desirable, but a more secure attachment than is afforded by the above method is seldom, if ever, required.

In the use of gold or silver solder for such purposes the facing and dowel should be attached by bending the pins, and the whole then *invested* and soldered in the usual manner. In using soft solder, however, no investment is necessary if the facing and dowel are placed upon a slightly heated charcoal or asbestos block or in a bed of asbestos fibre;

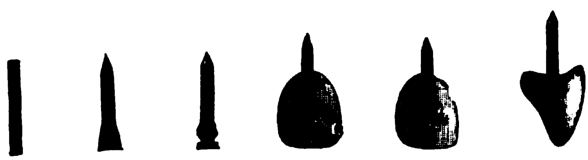


Fig. 181.

the proper flux then applied, and evaporated with heat, and the solder then fused by slowly directing the flame of a Bunsen burner or alcohol lamp upon the facing.

Use of Amalgam. A more artistic and finished contour of the lingual surface, as well as a more permanent adaptation of such crowns may be obtained by placing the facing and dowel (after their attachment) upon the root, and packing plastic amalgam over its end, and around the dowel, to the desired contour. After this has crystallized, it may be finished and polished, and then mounted. This procedure consumes more time, and entails more work than is usually indicated or warrantable for *temporary* purposes.

Use of Vulcanite. More artistic and permanent results may also be obtained by adapting the base and forming the lingual contour with wax, and subsequently flasking the crown and replacing the wax with vulcanite. In the process, however, it becomes necessary to "*tin*" the German-silver dowel, so that the vulcanite may become attached to it, and the entire procedure requires more time than that incident to the construction of a crown in a more practical and artistic manner.

Application and Construction of Porcelain Crowns.

CHAPTER XII.

Contraindications. Indications. Advantages: Esthetic; Anterior Crowns, Bicuspid Crowns, Molar Crowns. Hygienic. Mechanical; Attachment of Facing, Attachment of Molar and Bicuspid Crowns to Root. Application: Requirements; Strength of Metal Construction, Soldering, Oxyhydrogen Flame, Root Preparation. With Band and Dowel; Bands, Floor, Dowels, Accurate Fitting Dowels, Impression and "Bite," Facing, Investment, Soldering Facing, Anterior Crowns, Bicuspid Crowns, Molar Crowns; With Facing, Without Facing. Variations in Construction: Re-enforced Caps; Grinding off Pins. Leaving Pins Exposed. Without Band; Procedure, Plate and Dowel. Partial Bands; Procedure. Jacket Crowns; Indications for Porcelain Jackets, Procedure. Variation of Method. The Spaulding All-Porcelain Crown. Use of the Davis and Logan Crowns; Advantages, Disadvantages. Application of the Davis Crown, With Band, Without Band. Application of the Logan Crown; Procedure. Use of "Plastic" or "Mouldable" Porcelain. Johnston's Method.

After having passed through the various experimental stages incident to the development of its possibilities, the application of porcelain work, or the *ceramic art* has opened one of the most artistic and practical fields of dentistry, and is without doubt destined to become a permanent part of modern practice.

While the primitive efforts in this line were fraught with many discouraging phases, and replete with failures, and much of the resultant development must be attributed to the ever-increasing and constantly improving facilities; yet, throughout the entire era of its employment, from the time when the material was supplied in only one or two grades and colors; when the *coke* furnaces afforded the only adequate means for obtaining sufficient heat, and when the "baking" of a case required considerable effort and consumed much time, until the present, when it can

be procured in several grades and in varying colors; when the same procedure may be accomplished in the operating room in the presence of the patient, instead of the laboratory, at night; and at the expense of but little time or effort, the *possibilities* of such work from an *artistic* point of view have always been fully appreciated.

Since porcelain is a *mineral* substance, however, and in consequence possesses the characteristic of *friability,* the possibilities from the viewpoint of *strength*—which as a requirement is of equal importance with the esthetic—have been observed and recognized only in its more modern application; and have been attained mainly as the result of continued experimentation on the part of those who were sufficiently enthusiastic and progressive to ascertain the causes of failures, and endeavor to overcome them by the elimination of weak points.

As a result, the use of porcelain in its present form, and with the facilities available, make it possible for the skilful and experienced operator to achieve results which combine both of these requirements to a high degree. This is especially true of its application to crown and bridgework, in which its conservative employment may be productive of a class of work which more closely approaches the *ideal* than any other, by conserving the very highest possible esthetic and mechanical requirements.

In view of the *friable* nature of porcelain, however, the desired and necessary degree of strength is *not* to be obtained from *thin* layers, or *veneers,* but is dependent upon the presence of a sufficient thickness to insure the requisite resistance to stress. For this reason the possible strength of such work will naturally increase in proportion to the quantity which may be used in the individual case, *or in proportion with the bulk;* and for the latter reason, porcelain work in any of its phases is not universally applicable, but, on the contrary, has its definite prescribed limitations.

Hence the entire practicability of this class of work will depend upon, first, *conservative* or *judicious application,* and second, a *skilful execution* of all of the details incident to the construction.

The absolute necessity for scrupulous attention to detail, and for the utmost of painstaking care in its execution accounts to a large extent for the occurrence of failures, and elevates this class of work to a plane somewhat beyond the ordinary. Indeed, the successful manipulation of porcelain promotes and demands the acquirement of a degree of skill, and the cultivation of an artistic temperament, which is far beyond the province of those whose efforts are more or less encompassed within the range of indifference.

While failures will occur in any line of work, a very large proportion

of them in this particular class can invariably be attributed to an inadequate conception of the requirements, or *injudicious application;* or to unskilful or faulty construction and manipulation; either, or all, of which should reflect upon the inexperience or indifference of the operator rather than to cause or result in a premature condemnation of principles, methods and materials involved.

Contraindications.

For these apparent reasons the application of porcelain to the construction of *individual crowns,* to which consideration this chapter will be exclusively devoted, is contraindicated in all cases where the maximum length of the crown, or the close occlusion of the opposing teeth, precludes the presence of porcelain in *sufficient* thickness, or *bulk, to insure an adequate degree of strength;* and where nothing but an indestructible substance, like metal, could be relied upon to withstand the stress of mastication.

Indications.

As such cases present the *exceptional,* rather than the usual conditions, however, and hence constitute a small percentage of those requiring a restoration of the natural crown, the application of porcelain crowns, properly constructed, is especially indicated on the ten anterior teeth, and not infrequently upon the molars, in all cases which present a *normal* or *average favorable occlusion.*

Advantages.

The special advantages to be obtained from the application of porcelain crowns lie in the artistic manner and facility with which the natural conditions and varying characteristics may be closely simulated; the hygienic qualities of the material, and the possibilities for comparative and relative strength. These may be classified as *esthetic, hygienic* and *mechanical* and each will be separately considered.

Esthetic. While the possibilities for avoiding any display of gold are always very advantageous this esthetic feature is further supplemented by the absence of a metal backing, the use of which particularly on the anterior teeth is always more or less objectionable.

Anterior Crowns. In the construction of crowns for the six anterior teeth the reflection of the rays of light and its variations bear materially upon the color problem, and more artistic results are always to be obtained from the absence of a metal backing for the reason that its presence *destroys the translucency of the porcelain facing; changes its color,* and often occasions the appear-

ance of a dark blue line along the point between facing and backing. This latter unsightly and unhygienic condition is due to the penetration and decomposition of secretions, and is of course decidedly objectionable. While the translucency of the facing is slightly diminished even in a porcelain crown, it is by no means *destroyed,* and the other objectionable features are entirely eliminated, all of which are, particularly in this region, especially important considerations.

Bicuspid Crowns. In the restoration of the crowns of bicuspids the employment of porcelain is especially indicated because of the difficulty of obtaining the same esthetic effect, combined with the required degree of strength, in any other style of construction. Indeed the ease and facility with which both of these features may be obtained, as compared with any other style of crown, causes its application to be pre-eminently indicated on these teeth.

Molar Crowns. Although color and translucency are not so essentially important a consideration in crowning the molars, and granting the previously mentioned advantages of the gold shell or telescope crown for these teeth, there are nevertheless frequent indications for the application of porcelain crowns. Often on the *first,* and occasionally on the *second* molars, and particularly in the mouths of women, gold crowns are more or less conspicuous, and the use of porcelain may serve a highly esthetic purpose in these cases.

Hygienic. The hygienic properties of a smooth, highly vitrified surface, like that which presents in porcelain, constitute an important advantage of inestimable value in the mouth. Such a surface is more easily kept clean than that of gold because it is immune to the chemical action of the secretions, and food products will not cling to, become deposited upon, or be absorbed by it. For this reason, and possibly also because of its property of slow conductivity, it is least irritating to, and most compatible with, the tissues of the mouth.

Mechanical. Those advantages which have been classified as *mechanical* will be considered from the view-point of the relative degree of possible *strength* which may be obtained both in the construction of the crown, and in its attachment to the root.

Attachment of Facing. As the attachment of the facing is usually the weakest point in the construction of dowel crowns, in this connection the relative strength to be obtained from this style of construction as compared with a metal backed crown is a matter of much concern and of appreciable importance.

The probability of the subsequent occurrence of fractured facings in porcelain crown work is reduced to a minimum for the reason that, in a metal backed crown the facing is attached to the backing simply and only by means of the attachment pins, while, in a porcelain crown, this same attachment is also secured and then further supplemented by the fusion of the porcelain over the entire lingual surface of the facing.

The additional strength thus obtained by this combined means of attachment makes it practically impossible for the facing to be broken away from a well constructed crown. When such breakage or accident does occur, the entire mass of porcelain, including facing, will usually separate from the cap, which rarely happens, and which can be quite as often attributed to, and invariably indicates, faulty construction of the crown with regard to the means observed for the support and retention of the porcelain.

Attachment of Molar and Bicuspid Crowns.

In the attachment of molar and bicuspid crowns to the root a *possible* mechanical advantage is also possessed, even over gold crowns, because of the greater facility with which a *short* projecting end of the root *may* be properly prepared, and a *narrow* band accurately fitted, as compared with the requirements incident to shaping a longer projecting end of the root and adapting a wider band.

While the latter procedure may be somewhat more difficult, any possible advantage reverts, however, to the degree of skill with which the detail is executed, and unless the *esthetic* requirements indicate the application of a porcelain crown, or the root is primarily destroyed to a close proximity with the gum line, the preference should usually be given to the gold crown because of the conservation of tooth structure, and of the increased strength in the attachment between crown and root which may possibly be obtained in the use of a wider telescoping band.

Application.

In the application of this class of crown construction the highest possible advantages can be derived only from a careful observation of the requirements, combined with a skilful execution of the details in the preparation of the root; the construction and adaptation of the cap, and attachment of the facing; and the manipulation of the "body" itself.

When the conditions of occlusion are, or may be made, favorable, and when these details of construction have been executed with skill, a porcelain crown possesses adequate strength to meet the requirements in all average and typical cases; and the possible integrity in such work often exceeds that of any other style of construction.

Requirements.

To obtain such results with a maximum degree of strength, however, *three* essential requirements must be observed: First, the cap, or base, of the crown must be inherently *strong* enough to *retain its shape,* and afford ample means of *attachment* and *support* to the porcelain. Second, the facing must be *properly adapted,* and *securely attached* to the cap; and third, the selection and manipulation of the "body" must be made with a view to securing the best possible results.

Strength of Metal Construction.

In order that the requisite strength may exist in the metal parts they must be made of a material which will withstand the degree of heat required to fuse the porcelain; and a gauge sufficiently thick to retain its given shape must be used. Because of the practical infusibility of platinum, of its malleability, slight susceptibility to oxidation, and to the chemical action of the secretions, it is used almost exclusively for all of the parts for this work, excepting the dowel. For this purpose the alloy of platinum and iridium is used because of the softness of platinum alone, and of the additional stiffness imparted by the incorporation of various proportions of the latter metal.

Soldering.

In soldering the various parts *perfect contact* between all joints to be united should exist, and their union must be effected with a grade of solder which will not be *disturbed* or *re-fused* in the subsequent "baking" of the crown. For this reason 25% platinum solder should be used throughout the entire assemblage of metal parts if the *greatest degree* of strength is to be obtained, and its use is *absolutely necessary* wherever contact does *not* exist.

In the construction of single crowns, however, all of the soldering may be done successfully with the use of *pure gold* as a solder, *provided* that *absolute contact* of the parts has been secured, and that the gold is then *thoroughly fused* until all surplus *disappears* by becoming *absorbed by,* and *alloyed with,* the platinum.

This may be easily accomplished by the *continued* application of a small pointed flame from the ordinary combination mouth blow-pipe, and will be indicated by the disappearance of the surplus, and the blending of its color into that of the platinum. To secure this result with facility, however, it is highly important that only enough gold should be used to make the joint, and such a union will possess strength, and successfully withstand the degree of heat necessary to fuse the porcelain.

Should absolute contact not exist at any point in the joint the disappearance of the pure gold solder, which may be due either to absorption or to volatilization, will result in a subsequent opening and weakening of the joint, either from the heat of the blow-pipe or furnace.

Oxyhydrogen Flame. In the use of platinum solders, whether or not an investment is employed, the use of the oxyhydrogen flame is expedient, and often absolutely essential, and while the same might also be used with pure gold, it is entirely unnecessary.

As those requirements incident to the attachment of the facing, and the manipulation of the body, constitute important procedures in the construction of the crown, they will be considered in regular order.

Root Preparation. The requirements of root preparation are similar to those previously indicated in the application of any of the various styles of dowel crowns, with the exception that, for porcelain work, the root should be cut down until as *short as consistent* in order to secure as much space, and make as much accommodation for the porcelain as possible.

While an unnecessary waste or sacrifice of tooth structure is to be condemned as a general practice, for the above reason the root should be cut shorter for porcelain crowns than for any other style of construction, but, *if a band is to be employed a projecting* surplus end should always be allowed to remain until the *peripheral trimming* has been accomplished, the *measurement taken,* and the *band fitted.* This is necessary for the reasons previously mentioned in connection with the "band and dowel" crown, and the same shape is indicated for the basal end of the root as formerly recommended and illustrated for anterior roots in Fig. 50, and for bicuspid and molar roots in Fig. 53.

With Band and Dowel.

As the employment of a band is generally conceded to be productive of the most universally successful results, this style of construction will be given precedence in this consideration, and be followed by the variations, the indications for the application of each of which having been previously mentioned.

Bands. The band should be made of platinum not thicker than 28 nor thinner than 29 gauge, and the edges should be slightly overlapped before soldering. This method should be observed as a means of securing additional strength, and of precluding the subsequent opening of the joint from the expansion of the metal which is induced by the degree of heat necessary to fuse the porcelain. The *exact* length of the measurement of the root, taken in the ordinary manner, and cut and straightened as indicated, should be designated by cutting a small nick in the edge of a piece of platinum plate from which the band should then be cut about 1/8 of an inch wide, and with an allowance of about 1/16 of an inch surplus. (Fig.

182 A.) Each end should then be slightly beveled *on one side* with a file, and the band then annealed and made in circular form, with the surplus end, designated by the nick, *overlapping the outside* of the other end until the nick approximates evenly with this edge. (Fig. 182 B.)

The surplus overlapping end must be on the *outside* to prevent diminishing the size of the band, and the relation may then be sustained by pinching the ends closely together with flat-nose pliers, which produces a sharp angle on each side of the joint and affords a flat surface contact. (Fig. 182 C.) This will usually overcome a change in the relation as the result of expansion when heated, though a wire may be twisted around the band for this purpose if necessary.

The joint should then be soldered with a *minimum* quantity of 25 per cent platinum solder, or with pure gold, to prevent unnecessary stiffness, in the manner indicated.

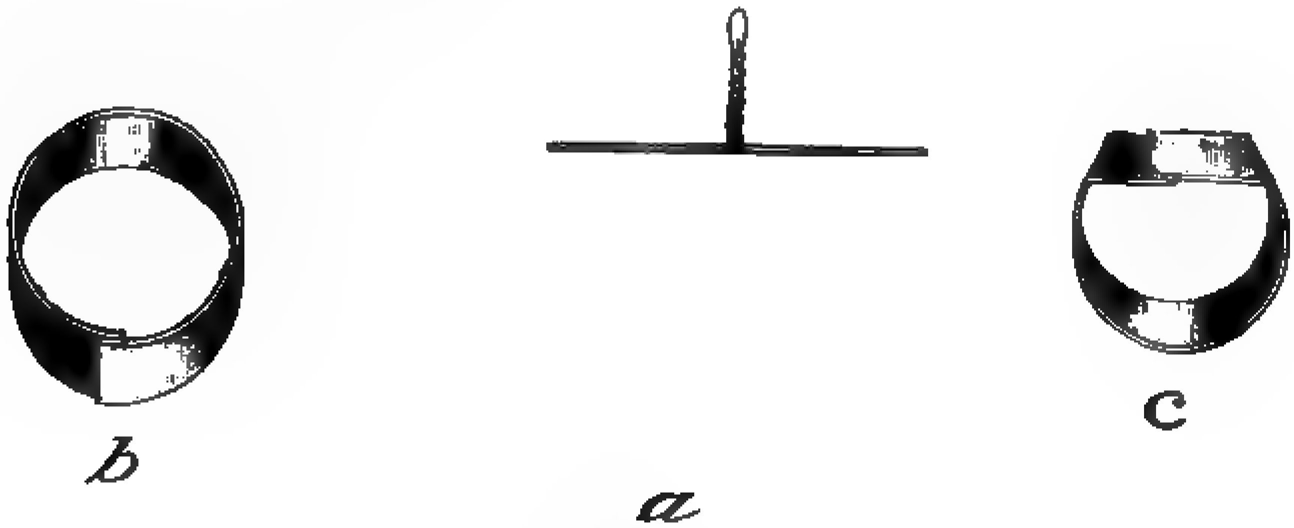


Fig. 182.

The band should now be trimmed to follow the cervical curvature of the gum, the edge nicely *rounded,* and then fitted to the root, and afterward cut away until *as narrow as possible,* in accordance with the detail previously described

Floor. The floor should be of about 32 gauge platinum cut somewhat larger than the diameter of the band. The band should be placed in position on it, and first simply *tacked* to place with a small quantity of solder. This primary attachment secures the relation and *anneals* the floor metal so that it may then be easily burnished into *close* and *direct contact* with the edge of the band, without danger of changing the shape of the latter.

The soldering may now be completed in which, if pure gold is used, it must be carefully noted that perfect contact exists around the entire joint, after which the surplus may be trimmed away and finished down with file and disks until flush with the edge of the band.

Dowels.

The dowel should be made of *round iridio-platinum wire* of a size proportionate with the size of the root and requirements of the crown, and fitted to the canal in the manner previously outlined.

The cap should now be adjusted to place on the root, the floor slightly perforated for the dowel at the proper point, and this perforation then *enlarged with the dowel* by forcing it to place. This insures a perfect contact between them which is essential to the strength of their union, and to the facility with which it may be accomplished.

The relation should now be temporarily sustained with gutta-percha or adhesive wax, until they may be removed, invested, and soldered as indicated. While any means of investment is often unnecessary because of the close relation thus existing, the simple means previously advocated for this *insures* their proper relation.

Accurate Fitting Dowels.

Where it may be desirable to have the dowel fit closely to the walls of the canal throughout its entire length, the method suggested by Dr. A. O. Hunt, and others may be used to advantage. This consists in rolling platinum foil 1-1000 into a cone, passing this cone into the canal and expanding it first with a tapering pointed instrument, and then by packing cotton into it, until it conforms to the shape of the canal. It may now be removed and filled with *platinum solder*, and then adjusted to its proper relation with the cap, as indicated.

The same procedure is also applicable to any kind of crown construction, and for gold work the cone may be filled with scrap gold or solder.

While iridio-platinum wire of a suitable size will usually meet all of the requirements of a dowel, one constructed in this manner possesses the advantage of being *largest* at the *junction between crown and root* which is of course the weakest point in the attachment of any kind of a dowel crown; and the use of such a dowel may be especially indicated in those cases where the canal has become abnormally enlarged from decay.

Impression and "Bite."

When the cap has been completed and finished, and adjusted to its proper position on the root, the usual impression should then be taken in plaster, and this *preceded*, whenever necessary, by a "bite" in wax.

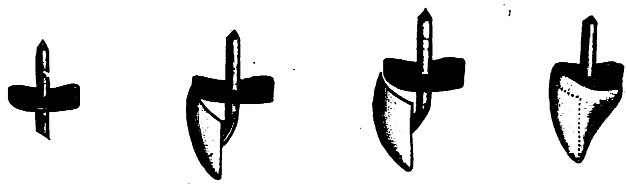
After securing the impression, it should be observed that the cap rests firmly in place in it, and, if necessary, it should be sealed with hot wax. The interior of the band and surface of the dowel should then be covered with a thin film of melted wax, to facilitate its removal from, and admit of its accurate readjustment to, the model.

This is of paramount importance in this class of work, because of the necessity for frequently trying to place on the model during the construction of the crown, and particularly in those cases requiring a restoration of occlusion.

Facing.

The facing should be selected in accordance with the requirements of color and size, and ground to conform with the desired shape and characteristics. As the color is more likely to be *slightly bleached* instead of becoming *darker,* if any variation is necessary or unavoidable, it should invariably be darker than lighter, though the best makes of porcelain teeth rarely change to any appreciable extent if the proper make and color of "body" is placed back of them, and properly fused.

In this connection, it is necessary to use a "body" the fusing point of which will not affect the color of the facing, as an example of which the use of the higher fusing American "bodies" in combination with the English make of facings will entirely destroy the color of the latter.



a *b* *c* *d*

Fig. 183.

In grinding the facing, the edge of the cap should previously be nicely *rounded* with disks (Fig. 183, A), and the cervical end of the facing then ground *thin* to admit of overlapping upon the labial or buccal edge of the band without causing undue prominence at this point. (Fig. 183, B.)

This is necessary as a means of bringing the edge of the facing into close proximity with the gum, and for the purpose of thus affording a *mechanical retention* to the porcelain with which this portion of the band should invariably be *completely covered.*

If the platinum band is not entirely covered upon this surface, it will always show through the thin transparent tissue, and occasion the presentation of a dark blue line, at this point.

As this is a decidedly inartistic and *undesirable* feature, and as there is *no physical union between porcelain and platinum,* the overlapping of the facing affords a secure mechanical retention for a sufficient quantity of porcelain to cover this portion of the band and overcome this possible objection, and result in a smooth flush joint in the finished crown.

Wherever it is desirable to retain porcelain in contact with platinum, some similar means of affording mechanical retention is always necessary, and this may be further facilitated by allowing a very slight space to exist between facing and cap. (Fig. 183, C.)

When the facing has been thus properly adapted, it should be sealed to place on the cap with adhesive wax, and the whole then detached from the model and invested.

Investment.

In investing, only enough material should be used to surround the crown nicely and afford sufficient strength in the investment; and when the material has crystallized, all surplus should be trimmed away until the *entire lingual surface of the facing is freely exposed.* (Fig. 184.)

This free exposure is necessary as a means of facilitating the soldering, and it may be made without increasing the danger of fracturing the facing, if the case is then *adequately heated* before attempting to solder.

Fig. 184.

Soldering Facing.

Before heating the case *the pins should be bent down toward the porcelain* until their ends may be brought into *absolute contact* with the metal parts. This may be done by holding the facing firmly in place with a blunt-pointed instrument in one hand, to prevent displacing it, while another instrument, held in the other hand, may be placed against the *extreme ends* of the pins and sufficient pressure applied to bend them into the desired relation.

Anterior Crowns.

While it is always desirable to get the pins down *close to the facing,* and thus make more room for the porcelain, and still have an equal degree of strength in their attachment, this is especially indicated in the construction of anterior crowns.

In these crowns the pins should be bent down close to the porcelain, and their ends brought into contact with the surplus end of the

dowel *at a point as close to the floor of the cap as possible* (Fig. 185, A), or in direct contact with the floor itself. (Fig. 185, B.)

This is important, because it affords opportunities for the same degree of strength in their union with the cap, and yet adds to that of the crown by getting the metal parts out of the way, so that they will not *divide* the porcelain through the center, or interfere with the proper and desired contour of the lingual surface.

In cases where the ends of the pins will not reach to the floor, or dowel, the space between them and the floor, after being bent down toward the porcelain, may be filled in with one or two thicknesses of platinum plate, or wire, if necessary, until *continuous contact* may be secured, as illustrated in Fig. 185, C. The finished crown, showing the possibilities of contour, strength and artistic effect, is illustrated in Fig 185, D.

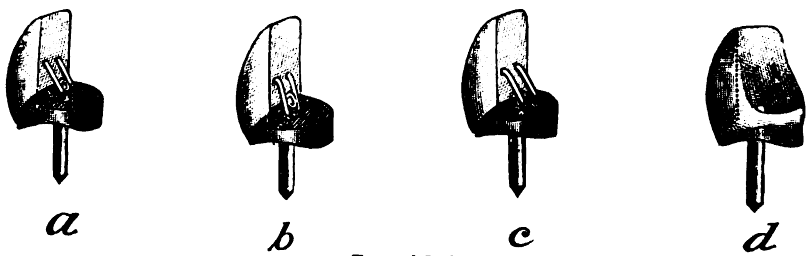


Fig. 185.

Bicuspid Crowns. As there is no physical union between porcelain and platinum, in the construction of bicuspid crowns, it is not only desirable to make as much space for the porcelain which is to form the entire lingual surface of the crown, as possible, but it is also often necessary to provide some means for supporting it against any possible line of *cleavage*, in order to preclude subsequent fracturing of this mass of porcelain from the stress of mastication.

This support to the porcelain, and destruction of any line of cleavage, may be best and most easily accomplished by soldering a narrow band of platinum about one-sixteenth of an inch wide to the floor of the cap, even with the edge of the band. This *should be fitted before heating the case*, and may be attached at the time of soldering the facing, and

its presence thus forms a cup-shaped support which admirably answers the purpose for which it is intended. (Fig. 186, A.)

Another means of accomplishing the same end has been suggested by Dr. Capon, and consists in adapting and attaching the floor to the *inside* of the lingual surface of the band, thus allowing the occlusal edge to project about one-sixteenth of an inch beyond the floor. This method retains and supports the porcelain in the same manner, but is much more difficult to adapt, and consumes considerably more time.

The same result was previously sought by attaching a small vertical extension of *round platinum* wire to the *immediate center* of the lingual portion of the cap. (Fig. 186, B.) Or, when two dowels were used, the surplus end of the lingual one was thus employed. (Fig. 186, C.)

Excepting in the latter instance, this is somewhat difficult to hold in its proper place while soldering, and may prove an element of weakness

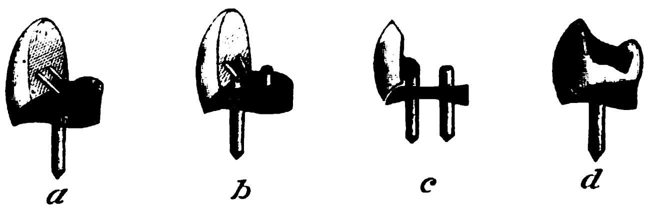


Fig. 186.

instead of strength, if not properly adjusted. For these important reasons such methods have practically been abandoned, and the former is now to be regarded as the typical and ideal type of construction, and is often indicated on incisors, cuspids and molars as well as biscuspids. The finished crown is illustrated in Fig. 186, D.

Molar Crowns.

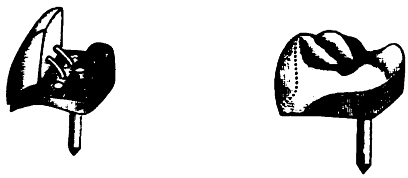
In the construction of molar crowns, *two* methods are employed. One consists in using a facing and observing similar details to those indicated in the construction of bicuspids, and the other in making the cap, and building the entire crown of porcelain without a facing.

With Facing.

While it is true that the requirements of color are not quite so important in molars, the best results will usually be obtained from the use of a facing whenever possible, for the reason that both the form and color of the visible parts of the crown are obtained and preserved in the facing.

When a facing is used, the construction should be made, as indicated for bicuspid crowns, and illustrated in Fig. 187, A, and Fig. 187, B shows the finished crown.

Without Facing. In very close "bites" the use of a facing may often be contraindicated, and the best results obtained by simply making the cap and forming the entire crown with porcelain. For such cases the porcelain should be supported by the means indicated for bicuspids, which, together with the finished crown, is illustrated in Fig. 188.



a b

Fig. 187.

Additional mechanical means for obtaining, or aiding in, the attachment of the porcelain to the cap may also be secured in any of these various styles of construction, by *roughening* or *spurring* the surface of the platinum with a sharp-pointed instrument. This latter method is employed exclusively by some, and may serve the purpose in large crowns,

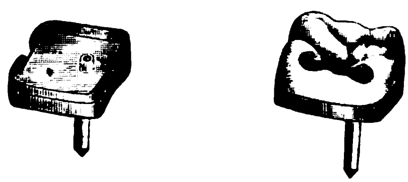


Fig. 188.

where considerable surface is exposed, without being supplemented by any of the former means.

Variations in Construction.

Because of the acknowledged advantages of a band, the foregoing style of construction has been given precedence, and designated as the *typical* one; yet, while it is true that crowns so made are perhaps more universally applicable, and productive of more permanent results, it is also true that there are many variations of methods of more or less value, the employment of many of which may be frequently indicated.

Reenforced Caps.

As inherent strength in the metal parts has already been claimed as a *prerequisite* in this work, one of the most useful variations in the construction is to be obtained by reenforcing the cap in a manner similar to that previously recommended in the construction of crowns with the so-called saddle-back teeth.

Such a procedure imparts to the finished porcelain crown a degree of strength which is appreciably valuable in many cases; particularly in bicuspid crowns, and in those cases where the crown is not supported by adjacent teeth on one or both sides, and where the absence of some of the opposing teeth necessitate more than average occluding stress.

This increased strength may be secured by allowing the floor to project slightly beyond the band upon the approximal and lingual surfaces, and then filling in the shoulder so formed with platinum solder until smooth and flush. The additional thickness of a cap so made further pre-

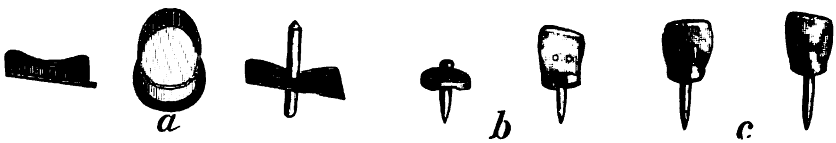


Fig. 189.

cludes the possibility of subsequent irritation to the surrounding tissue by affording a heavier, smoother and more rounding edge. (Fig. 189, A.)

Grinding Off Pins.

Since the pins of a facing may be an element of weakness in a finished crown in those cases where the natural crowns are very short, or where the artificial crown must be very *thin* in order to accommodate the occlusion of the opposing teeth, it may become necessary, or desirable, to cut them off close to the surface of the facing.

In such cases this may be done without materially diminishing the strength of the finished crown by so shaping the projecting surplus end of the dowel as to have it *mechanically retain* both facing and body.

In this procedure the pins may be used to sustain the relation of the facing to the cap until after the *first bake*, when they may be ground off close and the crown then completed. (Fig. 189, B.)

Leaving Pins Exposed.

Another variation applicable to similar conditions consists in bending the pins down until their ends come in contact with the floor, and then filling in between them with platinum solder, and subsequently making no effort to cover them with porcelain. (Fig. 189, C.)

Without Band.

That style of construction which involves simply the adaptation of a metal floor or base to the end of the root, and the attachment of a dowel and facing thereto, and which has previously been designated as the "plate and dowel" crown, is equally as applicable to porcelain work as to gold work.

Procedure. The indications and general principles, and the detail of procedure incident to the requirements of root preparation, and the construction of the base of the crown, are identically the same as previously outlined. The only exception is the variation which the completion of the crown with porcelain "body" instead of gold solder demands, and which includes the use of platinum and high-grade solder.

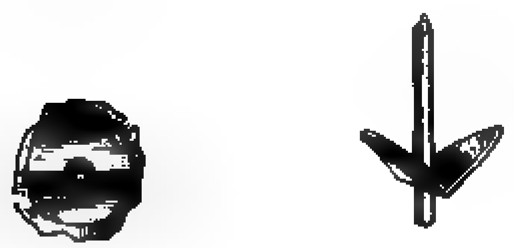


Fig. 190.

Plate and Dowel. Wherever a band is not desirable, for any reason, or where its use may be contraindicated, and the preference given to this style of construction, a plate of platinum about 36 gauge should be adapted to the end of the root, by burnishing or swaging, as indicated in Chapter X.

The dowel should then be soldered; the cap again adjusted to the root, and reburnished and properly trimmed around the edge, the models secured, and the facing attached by observing the requirements indicated in the immediately preceding style of construction, as are consecutively illustrated in Fig. 190. If the presence of this thin plate of platinum should be objectionable or conspicuous, it may be afterward removed by destroying its attachment to the dowel with a small round bur, carefully inserting the edge of a thin knife blade between it and the porcelain on the lingual surface, and gently lifting it away from the base of the crown. A slight deepening of the canal, or shortening of the dowel, will allow for its absence, and admit of placing the crown in close proximity with the root.

Partial Bands.

The employment of a partial band encircling only the approximal and lingual sides of the root, as a means of increasing the stability of the attachment of the crown, may also be made in a manner similar to that already mentioned.

As this style of construction serves to fortify the crown against stress in the direction in which it is usually imposed, and also renders this porton of the joint between crown and root more or less immune to the penetration of secretions, it at once recommends itself as a useful practice, especially indicated on the six anterior teeth, where the root is allowed to project slightly beyond the gum line on the lingual side.

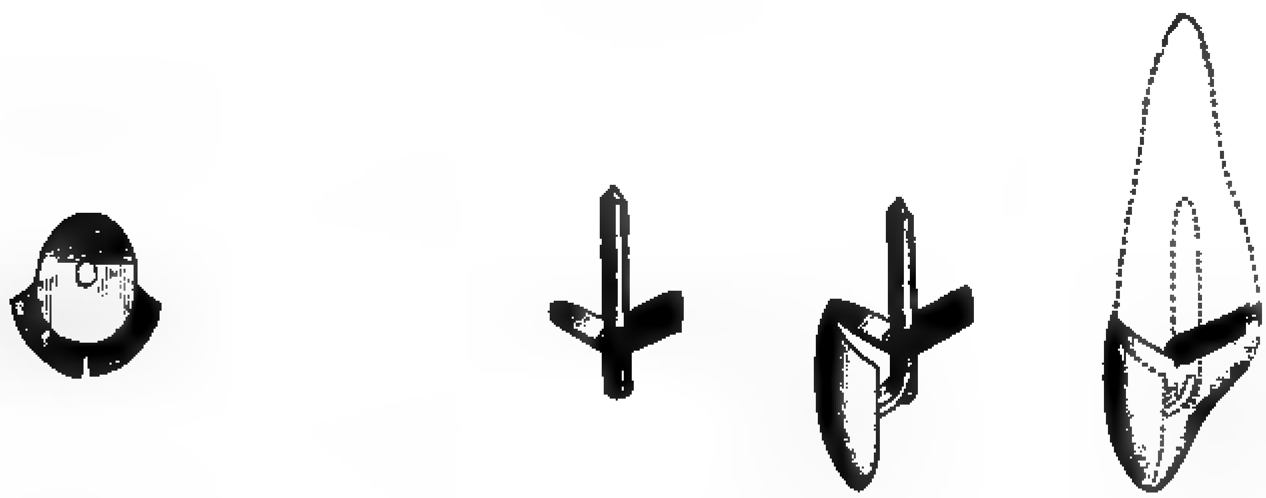


Fig. 191.

Procedure. The effect of a partial band to serve such purposes may be obtained with the greatest degree of facility by allowing a sufficient surplus of the plate to extend beyond the root on this surface, until the adaptation of the base has been secured, and the dowel soldered.

The cap may now be adjusted to position on the root, where it is held firmly by the presence of the dowel, and this surplus edge then burnished up close to the surface of the root, and finally trimmed to follow the curvature of the gum.

A surplus sufficient to admit of reaching the gum line, and passing just a bit beneath it, should always be allowed to remain, and if the accurate burnishing of this upturned edge is made difficult because of the length of the root, a slight incision through the surplus edge of the plate at the center of the lingual surface will facilitate the possible adaptation. This may be subsequently soldered, either before or after the impression has been taken, but should always be done before the porcelain

is applied. More than one incision may be sometimes indicated, and are permissible when necessary.

The various steps in this style of construction are consecutively illustrated in Fig. 191.

Jacket Crowns.

The principles involved in the so-called "jacket" style of crown construction, as applied to both gold and porcelain work, have been elsewhere considered, together with the indications, advantages and disadvantages governing their application.

The practicability of these crowns, however, when made in combination with porcelain, is apparently a question of much dispute, and has continued to be since the method, which was the primitive effort in the line of constructing porcelain crowns in combination with platinum, was first suggested by Dr. C. H. Land.

The advocates of this style of construction claim that it is more or less universally indicated in restoring the crowns of the six anterior teeth, upper and lower; and that the principal advantage lies in the conservation of tooth structure, and the preservation of the pulp.

While both of these considerations are always of material significance to the conscientious operator, and should be observed wherever possible, still they do not constitute the complete maximum of requirements of crown construction and application, even when combined with the highest esthetic possibilities, because the requirement of *strength* is, of course, of equal importance, having so great an influence upon the serviceability and permanency of the work.

In view of this fact, and also that the projecting end of the crown of the natural tooth, which is to be telescoped by the cap or "jacket," as a means of affording attachment for the artificial crown, is allowed to remain, or is preserved, at the expense of the thickness of porcelain which may be subsequently used in the construction of the crown; and, because of the *friable* nature of porcelain, particularly when used in small quantity, this style of construction is not to be recommended as a general or conservative practice, and is by no means universally applicable, if the most permanent results are desired.

In this connection, it seems more than probable that a large percentage of the early failures which marked the advent of the porcelain crown constructed for the individual case, and retarded the development of this work, may be attributed as much to the method of construction as to the use of the *low fusing bodies*, which were formerly employed.

Aside from the inherent weakness, which adequate accommodation

for the root in the body of the crown demands, the artistic possibilities are also often somewhat hampered by the more or less clumsy appearance of the finished crown.

Indications for Porcelain Jackets.

Whenever *an adequate length of the adjacent teeth,* and a *favorable occlusion,* will admit of overcoming these objectionable features, and securing a maximum degree of strength, jacket crowns may be constructed with porcelain, producing serviceable and artistic restorations.

Procedure.

In the application of this style of crown, the remaining natural crown should be favorably shaped to admit of the accurate adaptation of the jacket, and of the proper alignment of the facing, as indicated in the previous consideration, and illustrated in Fig. 192, A.

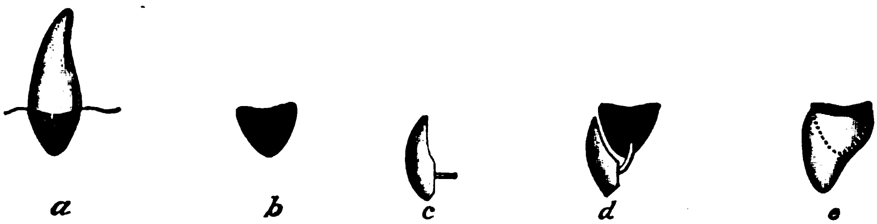


Fig. 192.

The measurement should be taken and a band of about 36 gauge platinum, wide enough to encompass the entire remaining natural crown, then made. The overlapping of the ends in this instance is not always advisable, because of the impediment offered to the burnishing by such additional stiffness.

When this has been accurately trimmed and fitted at the cervical edge, a cut in each *approximal* side of the band, beginning at the incisal and extending well toward the cervical edge, will facilitate the subsequent burnishing of the platinum into a close conformation with the root. A blunt piece of wood and a light mallet, or a smooth foot-plugger in an automatic mallet may be found useful in this procedure, but care should be exercised to avoid drawing the cap down from its proper cervical relation.

The edges should now be pinched together with pliers around the incisal end of the root until in close contact, the cap then removed, the surplus trimmed away, and the joints soldered. Pure gold will answer

nicely for this purpose, if used *sparingly* and properly fused, though platinum solder is preferable.

Platinum foil, No. 60 or 120, may often be used in securing the proper adaptation around the cervix, and slightly beneath the free margin of the gum, to which point it should be carried, because of the greater facility with which it may be even more closely adapted; and extreme thinness of the cap, on the labial surface, at least, is also advantageous to the subsequent adjustment of the facing. In the use of the foil, however, when the proper adaptation has been secured by burnishing, with the surplus overlapped upon the approximal and lingual surfaces, the cap should then be slightly re-inforced with platinum solder, or pure gold thoroughly fused.

The best results are doubtless to be obtained, as a general practice, from the use of the heavier cap, and while *pure platinum is not as soft and malleable as pure gold,* if the piece is well annealed in the porcelain furnace, as recommended, no great difficulty will be experienced in adapting platinum of 36 gauge to the requirements of these cases. If preferable, the adaptation may be secured by taking an impression of the end of the root, making dies and swaging, as previously described.

The entire surface of the cap, however made (Fig. 192, B), should now be slightly roughened with a sharp chisel, or other convenient instrument, to facilitate the attachment of the porcelain, and the impression taken with it in position on the root. Before filling the impression, the cap should be filled with wax to facilitate its subsequent removal from the model.

A very *thin* facing (Fig. 192, C) of the proper size and color should now be selected and ground to its proper adjustment. This sometimes requires that the entire lingual surface, including pins, be ground away until only a very thin *veneer* remains, but it is best to allow the pins to remain also, if possible, because of the advantage to be derived from their presence in securely sustaining the relation of the facing to the cap, by bringing them in contact and soldering, previous to applying the porcelain. (Fig. 192, D.)

Where it becomes necessary to grind the pins away entirely, the difficulty of sustaining the *veneer* in its relation to the cap during the application and fusing of the "body" is, of course, increased, and extreme care is necessary in heating the case, because of the possible expansion incident to too rapid heating; and in fusing, because of the shrinkage, each of which may result in a displacement.

This procedure may be facilitated by first covering the cap with a thin layer of "body" and fusing it until the particles are well coalesced, without presenting a glazed surface. This then admits of a more ready

and secure attachment of the veneer to the cap by holding it in place and packing thinly mixed body into the space between it and the cap, until it is retained in position by the adhesive properties of the body after the moisture has been evaporated, when it is ready for the final attachment to be obtained by the fusion of the porcelain. Fig. 192, E, illustrates the finished crown.

Variation of Method.

A method of veneering platinum and gold crowns constructed in the ordinary manner, excepting that the dimensions are reduced enough to admit of the presence of a covering of porcelain, which is retained in contact with the metal by roughening the surface, is recommended by Dr. George Evans and others, as a means of securing the presentation of a more esthetic effect, combined with the advantages of a metal crown.

As *thin* layers of porcelain, whether of the high or low fusing variety, *do not possess strength,* and as *there is no physical or molecular union between porcelain and platinum, or gold,* the method is not considered to be a safe or reliable one.

The Spaulding All-Porcelain Crown.

That which seems to be the ideal method of constructing a "jacket crown" has been suggested and is practiced extensively by Dr. E. B. Spaulding, of Detroit, Mich. In this type of construction the presence of a platinum cap in the completed crown is avoided, and thus this element of inherent weakness is eliminated. Hence, even though the finished crown is but a shell of porcelain, it is stronger than the former style, wherein a thin platinum cap remains as an integral part of the crown; and when this "shell of porcelain" is properly and skilfully adapted, and then supported by the mounting medium, it seems to offer every opportunity for obtaining the highest possibilities in the line of combined esthetic and mechanical requirements. Dr. Spaulding describes his method as follows:

Technique of All-Porcelain Crown Work.

The following process in detail for preparing the tooth, forming matrix, adapting veneer and fusing, I have adopted after considerable experiment and practice, as being the most simple, direct and accurate means of producing a uniformly successful result.

Let us first look at Figs. 1 and 2, Plate A, to get a better idea of what it is we wish. Fig. 1 shows a tooth properly prepared, enamel

removed to the shoulder at the gum line and dentine more or less cone shaped. Its shell of porcelain is seen above, and when in place on the tooth fits as nicely as shown in Fig. 2, joint everywhere flush and almost, if not quite, as tight as an inlay joint.

When a tooth in the mouth calls for treatment in this manner it is usually because of deficient enamel; consequently there is not the large amount of enamel to remove which would be found on a normal or perfect tooth.

We will imagine an upper central incisor, the enamel of which is lacking on the labial surface from erosion, and we desire to remove the remainder of the enamel, preparatory to making a porcelain jacket.

Method of Removing Enamel.

We first take a ⅞-inch, thin, separating carborundum disk (rubber and carborundum), mounted in the engine hand piece and, being revolved at a high speed and kept wet with a stream of warm water from the syringe in the hands of an assistant, the mesio-approximal surface is removed in the manner indicated in Fig. 3. Commence at the cutting edge and move the disk toward the cervix. Where the disk is stopped at the gum, a shoulder is left such as is desired around the entire tooth when the preparation is completed, and this shoulder should be at, or slightly below, the gum line.

The disto-approximal surface is dressed in like manner and the remaining enamel removed from the labial and lingual surfaces by means of a ½-inch knife-edge carborundum stone (not disk). This removes the enamel from four sides and leaves four corners to be rounded off by means of the disk again, approached at different angles.

Up to this point we have paid little attention to the shoulder except as left by the disk on the approximal surfaces. By the use of the smallest inverted carborundum stones on the market (3/16 inch, No. 184, Lee, Smith & Sons) mounted with shellac on an old bur, the shoulder on the labial surface is partially dressed, and a similar stone mounted on a right angel hand piece bur, accomplishes the same result on the lingual surface. The shoulder is finished and receives its definite line by means of sharp wheel burs. Let the use of *new, sharp* knife-edge stones and *new, sharp*, wheel burs be emphasized, for a dull bur and a dull stone both cause pain. The point, or cutting edge of the tooth, is shortened and the whole treated with a few quick touches with a sand-paper disk to smooth and complete the preparation of the tooth to receive the matrix. For convenience, we will call the prepared portion of the tooth the conical portion.

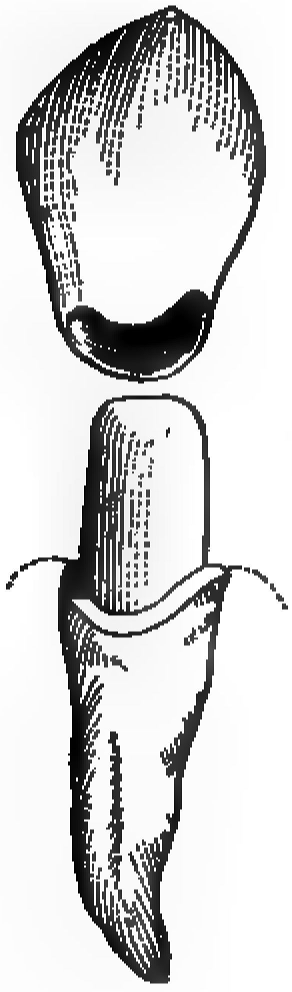


FIG. 1

FIG. 2

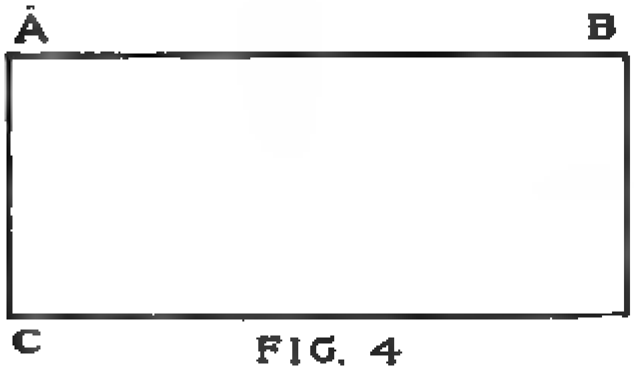


FIG. 4

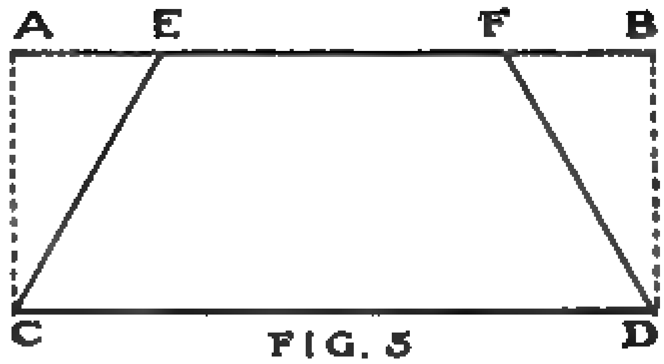


FIG. 5

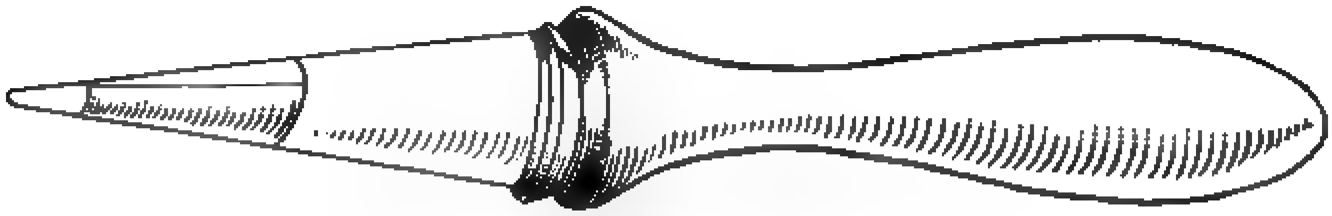


FIG 6

FIG. 7

PLATE A

In preparing the tooth in this manner we have not encroached upon the pulp at all, and what would seem to be an excruciatingly painful operation is really little more annoying than the preparation of cavities, as we do almost every day.

Forming the Matrix.

The first step in forming the matrix is to obtain the circumference of the tooth *over the shoulder and under the gum.* This is done by means of a dentimeter, or by a thin strip of copper or other metal pinched about the tooth. This measurement is more conveniently taken before the tooth is prepared and the shoulder formed.

Now cut a piece of inlay platinum (1/1000 inch) 1/16 inch longer than the measurement taken and 3/8 inch broader than the length of the conical portion of the tooth from the shoulder to the point. This rectangular piece of platinum, as shown in Fig. 4, is now changed by cutting off the angles "A" and "B" to the form C, E, F, D, Fig. 5. The edges C, E, and D, F, are lapped 1/32 part of an inch, the cone shaped instrument, Fig. 6, assisting to bring the edges of the platinum in absolute contact, which is then firmly held in the pliers (Fig. 7) while the end of the seam is soldered with a very small particle of pure gold. As soon as part of the joint is soldered, loose the pliers and grasp the platinum on the side opposite to the seam, and if the edges are in absolute contact, there is sufficient gold present to complete the union of the edges when the heat is again applied. The very smallest particle of gold should be used in soldering.

Fig 8 (Plate B) shows the platinum cone, which is 1/32 inch larger at its base than the circumference of the tooth, and when placed over the tooth, will slip over the shoulder and under the gum.

The advantage of the cone is now shown in Fig. 9, for the farther over the tooth it is carried, the tighter it becomes at the points G and H, where the fit of the matrix *must be exact.*

Now, with a piece of No. 27 gauge copper wire in the dentimeter, a loop is placed about the cone (Fig. 10) and is alternately tightened by twisting, and carried toward the shoulder with a burnishing instrument until the wire has been worked carefully into the angle between the shoulder and the conical portion, carrying the platinum with it and shrinking it to the tooth. During this stage of the process, the forefinger of the left hand has been held tightly on the point of the cone to keep it firmly in place. The wire is now tightened as much as possible without breaking it, and serves to hold the platinum firmly while the next stage of the burnishing is done.

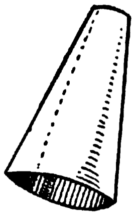


FIG. 8

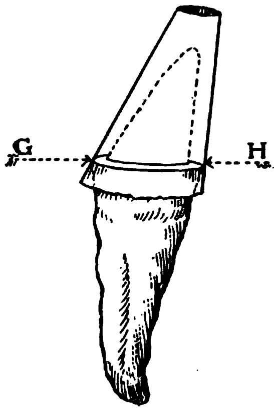


FIG. 9

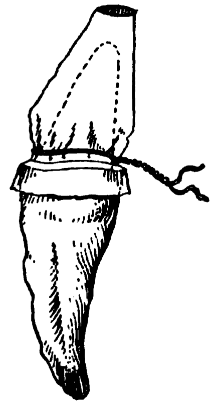


FIG 10

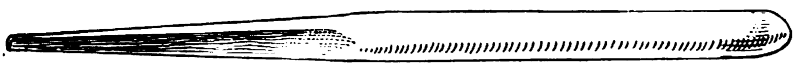


FIG 11

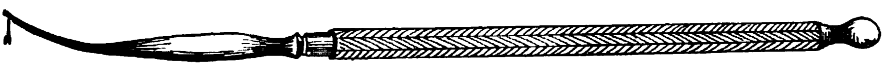


FIG. 11A

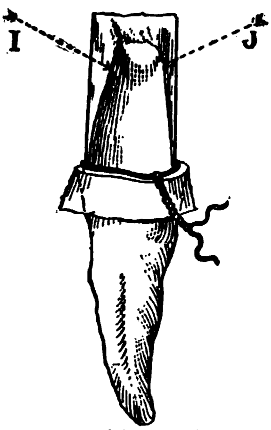


FIG 12

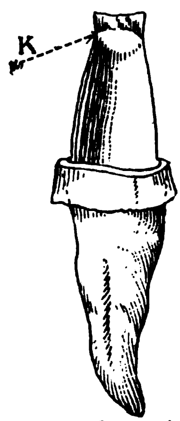


FIG. 13

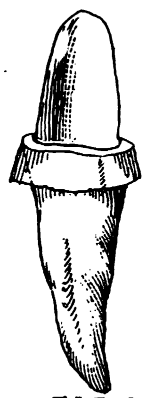


FIG. 14

PLATE B

The burnishing instrument (Fig. 11) is made from a bone handle of a mouth mirror, and its shape is seen in the illustration. With the thumb and forefinger the platinum is pinched to the conical portion, aided by the burnisher and narrow nosed pliers, or tweezers, so that the surplus is carried to the approximal sides (Fig. 12, I and J, Plate C). Now trim the surplus, leaving an extension of about 1/32 to 1/16 of an inch, which is lapped over and burnished down smoothly on the sides, but not on the point, as in Fig. 13. The wire is now removed and the platinum thoroughly burnished over the shoulder and into the angle, using besides the the bone burnisher the small "V" shaped steel burnisher (Fig. 11 A). The unburnished point of the matrix (K, Fig. 13), is now grasped in the pliers and the matrix removed and replaced once or twice to make certain that it does not bind at or below the shoulder. This done, the point is lapped and burnished, as were the sides, and the matrix is completed (Fig. 14).

Preparation of the Porcelain Veneer.

The next step is the preparation of the veneer, which forms the labial portion of the jacket.

The proper shade and shape is preferably selected in a vulcanite tooth on account of its shoulder (L, Fig. 15), which assists in adjusting to the matrix. The back and pins are ground away until a very thin veneer is left, as in Fig. 10. This grinding is not so laborious a task as might be supposed if small knife-edge carborundum stones are used together with the little inverted cone stones (No. 184) previously mentioned. The stones should be kept thoroughly wet during the grinding, and the veneer tried on the matrix, which is in place on the tooth, from time to time, in order to bring it to proper alignment with the other teeth. When it assumes the desired position, the cervical end of the veneer is shortened, so that it does not touch the shoulder, as at M, Fig. 17. It is now thoroughly washed to removed all particles of carborundum, and adjusted to position, where it is held with finger of left hand while a small ball of wax (gutta percha base-plate wax preferred) is warmed and pressed against the lingual portion of matrix and veneer, imbedding them so that they are held in their proper relation (Fig. 18). Usually the veneer and matrix are held firmly enough by the wax, so that they are removed from the tooth together, but if they should separate, the wax and veneer remain together and the matrix is readily teased off the tooth and placed in its position between the wax and the veneer.

Having a pair of tweezers, with sliding band for locking them, place a small piece of vulcanite rubber on one beak; insert the bare beak within the matrix and let the one protected with the rubber rest on the outside of

FIG 15

FIG. 16

FIG. 17

FIG. 18

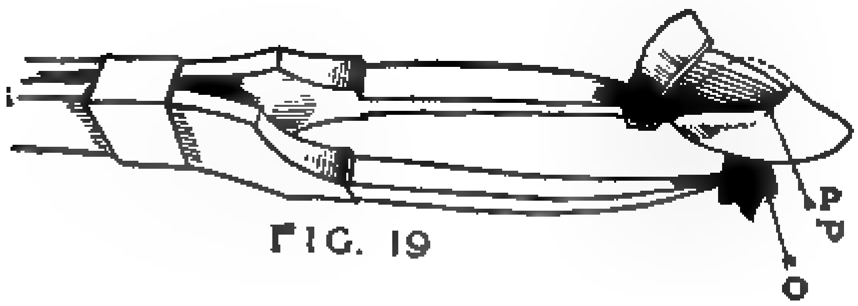


FIG. 19

FIG. 20

FIG. 21

PLATE C

veneer; close and lock. Remove the wax, and the matrix and veneer will be found to be held firmly in their relative position, as is shown in Fig. 19.

The gutta percha base-plate wax (N, Fig. 18) is not excessively sticky, and is black, and if any particles remain they are readily seen and removed before applying the porcelain body. O, Fig. 19, shows how the rubber is utilized to prevent beak or pliers from slipping on surface of veneer.

Adding the Porcelain Body.

The body is first applied on one side, only at the point indicated by the arrow P, in Fig. 19, and, being mixed rather thin at first, the tweezers are thoroughly jarred by drawing across them a rough handled instrument until the moisture is seen to appear on the opposite side of the matrix, corresponding to where first applied. This shows that all the air between the matrix and veneer has been driven out by the moist body. Now additional body is applied in a much drier state, until the matrix is covered only so far as indicated by the dotted line in Fig. 19. In no case let the body reach the shoulder before the first fusing. The moisture being thoroughly jarred out, the work is ready for the first fusing. Remove the pliers, when the matrix and veneer will be found to be held firmly by the body so that the whole will stand upright, resting on the base of the matrix, and is carried on the slab into the furnace in this manner. At the time of first fusing the moisture should be dried out slowly, for if heated too rapidly the moisture between the matrix and veneer will form steam and throws the veneer off. Let the work be slowly moved into the furnace, so that the veneer faces and receives the heat first.

Reburnishing.

After fusing, place the united veneer and matrix on the tooth and the portion of the matrix over the shoulder of the tooth is again burnished to correct any possible changes which may have taken place during previous handling. Removed, and again washed, the matrix is completely covered with body flush to the shoulder line and built up and carved on the lingual and approximal surfaces, as the case may require. There may be as many fusings as the operator deems necessary to produce the desired result. How nearly the finished article resembles the shape and shade of a natural tooth must depend upon the operator's knowledge of tooth anatomy, his artistic eye and his ability to manipulate porcelain.

Fig. 20 shows shell complete before matrix is removed. The matrix is removed much as it is from an inlay, by pulling away the sides with a pair of tweezers, care being used not to let them slip and strike the edge of the shell to chip it. If the matrix clings very closely up in the point, it

is readily detached with a small bur in the engine. (See Figs. 1 and 2 or shell complete, with matrix removed.)

Setting.

Before setting in place with cement, the inside of shell is etched with hydrofluoric acid, to provide a surface for the attachment of the cement. The dentine of the tooth should be varnished with a good cavity lining before cementation. The cement should not be mixed too thin, neither should it be so thick that much force is necessary to carry shell to place, as it might be fractured in this way.

A question which will readily suggest itself is, does not the grinding out of the porcelain tooth to form so thin a veneer change its color, and also, will not the cement change its shade when set in place? That is answered by saying that the portion of the porcelain tooth ground away is usually yellow, of a varying shade, and the characteristic blue, brown or other shade is retained in the veneer, and when a cement is chosen, a yellow is selected, which will replace the underlying yellow, ground away. It is possible to influence the shade of the shell somewhat in the choice of a cement.

By the completed and cemented shell we have a live and healthy tooth, thoroughly protected from injurious external influences. Experience teaches us that a tooth is never so comfortable with a metal filling or metal crown as it is with a porcelain inlay or porcelain shell. It is more artistic and natural than any other style of crown. No other crown has so flush and tight a joint, and the irritation of the gum, characteristic of band crowns, is entirely absent.

Lastly, it has strength to withstand severe use in the mouth. As a shell uncemented it is frail, but when thoroughly supported by cement it has the endurance almost of the natural enamel.

The Porcelain Body.

The porcelain body used in constructing these shells should be of a very high fusing body, or what is termed block body, or porcelain tooth body. While the Consolidated high fusing body will answer nicely, block body may be prepared by taking the bicuspids and molars of a set of diatoric (pinless) teeth and pulverizing them in a wedgewood mortar. One tooth at a time is taken in the mortar, and when it is fractured into a number of small pieces they are emptied upon a sheet of white paper and an assortment made, separating the pieces composed of the clear blue, or characteristic color of the cusps of the tooth from the remaining yellow. which forms the bulk of the tooth. The blue is powdered separately from the yellow. and the amount of each obtained from a set of four molars and

four bicuspids gives us sufficient body of these two shades to last some time. Four shades of body, two blues or grays, and two yellows, are usually all the variety needed in this work when a veneer is used. This very high fusing body has several advantages for this work over many of the *so-called* high fusing bodies found on the market.

First—The body is of exactly the same material as the veneer, so that when completed the shell is of one grade of porcelain. The advantage of this is, that the union of veneer and body is more complete, although, the body having been once fused and refritted, fuses at a little lower temperature than it did the first time.

Second—There is less shrinkage.

Third—There is not the liability to cracking or checking upon cooling that there is when a lower grade of body is used in connection with the veneer.

Fourth—No matter how many times the work may be fused, there is no danger of its becoming porous if it is kept absolutely clean, but a lower fusing body will frequently become porous when fused a number of times, due to the burning out of the flux which it contains.

What is known as *low fusing* (gold matrix) porcelain has no place whatever in connection with this work.

"A" (Fig. 21) is a plaster model of a typical case of malformed enamel due to impaired nutrition from birth, to about four years of age.

Model "A" was made in June, 1902, after which the irregularity of the teeth was corrected, and in July, 1903, the six anterior teeth were covered with porcelain by the process just described. "B" is a model of the case after it was completed. Age of patient at completion, nineteen years.

Use of the Davis and Logan Crowns.

Ready-made porcelain crowns, such as the Davis and Logan designs, may sometimes be employed to good advantage in porcelain work for the six anterior teeth, by combining them with a platinum *plate* or *cap*, as a means of securing accuracy in the adaptation and permanency in their attachment to the root.

Advantages.

The advantages to be obtained in the use of these crowns in this work lie in their artistic form, their unexcelled strength, and the greater degree of translucency which the finished crown will possess, as a result of the absence

of an additional layer of either metal or porcelain placed on the back of the original crown.

While their artistic shape is not to be disputed, the experienced porcelain worker, with a knowledge of tooth-form, will have no difficulty in building the body to an equally artistic outline, where a *facing* is used, so this feature is to be seriously regarded as a consideration only as a means of doing without the knowledge, and avoiding the small amount of time and work thus involved.

The inherent strength of the porcelain of which these crowns are made, which is obtained from the high fusing character of the "body," and from its then being properly *packed* and *fused,* is doubtless greater than the strength of the porcelain part of a crown constructed with a facing. Hence, this feature must be regarded in the light of an advantage of importance, and yet, where a simple facing is used, sufficient strength may ordinarily be obtained by *securely* attaching it to the cap, using a high-grade "body," and properly packing and fusing it.

The greater degree of translucency is indisputably true, and constitutes an advantage of inestimable value in many cases, particularly where the color is extremely difficult to match. While the texture of an ordinary facing may be practically the same as that of these crowns, and it may primarily possess the same degree of translucency, yet this important feature *is,* nevertheless, destroyed to some extent even by the presence of a backing of porcelain, of nearly, if not quite, the same color. This is due to the dividing line between, and the difference in the density of, the two bodies.

These features of *strength* and *translucency* are so important as to indicate the practicability and warrant the use of these crowns in many cases, perhaps, in preference to any other style of construction, where a good selection may be obtained.

Disadvantages.

The principal disadvantages lie in the fact that one is confined to a more or less limited selection, and that the opportunities are greater for securing a better choice of facings than of crowns because of the latter being limited to a few dozen moulds, as compared with the several hundred in which the facings are made; also the more intricate procedure, and greater length of time consumed, in grinding the crown to a proper adjustment and relation as compared with the facing.

Application of the Davis Crown.

Because of the greater facility with which a crown with a separate dowel may be adapted to the root, the Davis crown will be found particularly useful and applicable to this style of construction.

The accompanying dowel, however, is useless, and must be replaced

with one of iridio-platinum, because the so-called German silver alloys will scarcely withstand the degree of heat necessary to subsequently fuse the porcelain, and the latter will not become attached, or even fuse down close, to these alloys.

With Band.

In the application of this style of crown with a band, the root should be prepared, the cap made, the dowel attached, and the impression taken, in exact accordance with the requirements indicated for the "band and dowel" style of construction with porcelain, at the beginning of this chapter.

When the model has been secured, the cap should be detached therefrom, then replaced, and the crown selected.

The surplus end of the dowel should now be cut away until only so much remains as will be accommodated by the depth of the countersunk cavity in the crown, and the latter should be ground to the proper and required adaptation with the cap and the adjacent and occluding teeth.

Fig. 193.

In this procedure the approximal sides should be ground so as to admit of the overlapping of the labial and lingual edge of the crown upon the cap. (Fig. 193, A.) This is essential for the purpose of bringing the edges of the crown into close proximity with the gum and of retaining the porcelain which is to be subsequently applied to cover the band.

Owing to the shrinkage of porcelain, it is impossible to get enough body between the crown and cap in the first or *primary* "bake" to completely fill the space. This would result in an element of weakness, of course, in the finished crown, and may be overcome by further grinding away the approximal surfaces of the crown, so as to afford opportunity for the admission of a second application of "body," which may fill all crevices caused by the shrinkage of the first. (Fig. 193, B.)

When the grinding of the crown has thus been completed, it should be attached to the cap by filling the countersunk cavity in its body with

thin, well mixed porcelain, and then gently forcing it to place while on the model. The latter should now be gently tapped with an instrument several times to *pack* the porcelain *densely* around the dowel, and in the space, and it should then be allowed to dry until all of the moisture is thoroughly evaporated.

The crown should now be gently removed from the model, adjusted to a proper support, and given the *primary* "bake," and subsequently the *final* one, in accordance with the requirements which will be considered later. The completed crown is illustrated in Fig. 193, C.

Without Band. When it is desirable to construct the crown by this method *without a band,* the foregoing detail is *identical with the requirements,* after the "plate and dowel" have been properly adapted to the root and the impression taken

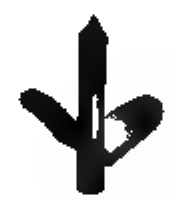


Fig. 194.

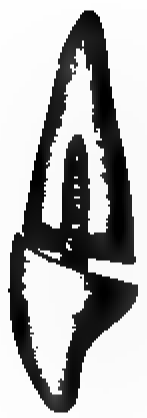
and model secured, which procedure has been previously considered in its special application to porcelain work in this chapter. The various steps in this style of construction are illustrated in Fig. 194.

Application of the Logan Crown. The Logan crown may be used in similar manner, with either a band or simple plate, and the difference in the procedure incident to its employment lies in the absence of any necessity for using other than the original dowel, which is of platinum and which constitutes an inseparable part of the crown.

The presence of an inseparable dowel in this connection, however, adds somewhat to the detail involved in grinding the crown to the required adaptation with the cap or plate, and necessitates subjecting the porcelain

to the heat of soldering in attaching it thereto, which, of course, is not true in the use of the Davis crown.

Procedure. In the application of this crown in combination with porcelain and a platinum cap or plate, the same detail as indicated in connection with the use of gold should be observed.



a *b* *Fig. 195.* *a* *b*

The base should be constructed of platinum of the same gauge as for the Davis crown, and the temporary dowel should be adjusted, the impression taken, and the model secured in accordance with the detail previously outlined in the consideration of this style of crown in combination with gold.

Fig. 196.

The crown should be then selected, ground as thus indicated (Fig. 195, A), attached to the base with a minute quantity of adhesive wax, removed from the model, invested, and the relation between the base and dowel permanently sustained with a small quantity of pure gold, to preclude any possible change which might result from the shrinkage of porcelain.

The soldering may be done with greater facility by covering the entire crown with investment material, leaving only the surface of the base, which comes in contact with the root and the dowel, exposed. (Fig. 196.) Considerable care must be exercised in this procedure, however, to prevent fracturing the porcelain, which can only be avoided by *thoroughly heating* the latter before attempting to solder. This space between base and crown may then be filled with porcelain "body" and fused, and the finished crown is illustrated in Fig 195, B.

Use of "Plastic" or "Mouldable" Porcelain in Effecting Adaptation.

Various forms of extremely low fusing compounds of porcelain and other basal ingredients combined, and known as "Plastic" or "Mouldable" porcelain, are being recommended and used to some extent in effecting a more accurate adaptation of any of the various forms of ready-made porcelain crowns, than could be obtained by grinding.

In the use of such compounds they are mixed to a thick putty-like consistency, and after the crown has been ground to an approximate adjustment, this is then placed over the base and forced to position on the root, thus moulding it to the outline of both the base and periphery of the latter. The surplus is then trimmed away flush and even, and the crown placed in the furnace and baked, the result being a very accurately adapted crown.

Johnstone's Method.

A very ingenious method of obtaining accuracy in a somewhat similar manner has been devised by Dr. A. P. Johnstone. In this process the adjustment is affected by first moulding *wax* to the base of the crown and end of the root, in the manner just previously indicated, and then investing the crown in an instrument designed for the purpose, and which, together with little low fusing buttons of porcelain, affords opportunity for accurately and automatically reproducing the wax base with porcelain. This very useful devise is manufactured by the Brewster Dental Co., of Chicago.

Either of these procedures is an improvement upon the former method of grinding the adjustment, and affords a far greater degree of accuracy.

Composition, Characteristics and Manipulation of Porcelain Bodies.

CHAPTER XIII.

Porcelain Compounds: Composition; Silica, Feldspar, Kaolin, "Flux," Coloring Matter. "High and Low" Fusing "Bodies": Comparative Advantages. Shrinkage, Fusing Points. "Gum Enamel" "Bodies." Requirements for Crown and Bridgework. Manipulation of Body: Preparation of Crown, Selection of Color, Mixing "Body," Applying and Building. One Grade of "Body." Variations in Shading; Use of Oil Colors; Contouring and Carving. Primary "Bake." Final "Bake." "Foundation" and "Enamel" "Bodies." Precautions Incident to Fusing. Supporting Crown in Furnace. Placing Crown in Furnace. Heating Furnace. Fusing: Tests, Porosity. Furnaces: Electric Furnaces, Gasoline Furnaces, Gas Furnaces.

Porcelain Compounds.

With the rapid development of this class of work, a demand has been created for the production of porcelain compounds which possess qualities better suited to the requirements of *manipulation* and *color* than was characteristic of those which were formerly used, and which had been especially prepared for continuous gum work.

This latter grade of material, as originally compounded by Dr. John Allen, and later by Dr. S. L. Close, in the absence of anything better, was quite commonly used, and, when more finely pulverized to admit of being carved and fused with greater accuracy, it served the purpose so well as to be, to a great extent, responsible for the growth and development of this class of work to the degree of its present successful attainment.

As it was prepared in only one grade and color, however, the de-

mands created by the possibilities of this work soon induced other manufacturers to so alter and improve upon these materials as to furnish compounds which would be somewhat less refractory, and which would more nearly meet the requirements, with the result that several products are now prepared in different grades and varying colors.

Composition. These various compounds are supplied in powder form, and are known as "bodies," "enamels," and "gum enamels." They are composed of silica, feldspar, kaolin and a suitable "flux," and are colored, or tinted, with metals or metallic oxides.

Silica. Silica is the dioxide of silicon, a very refractory and practically infusible substance found in the form of agate and flint. It is the base of all true porcelain "bodies," and imparts *structural strength* to them.

Feldspar. Feldspar is a double silicate of aluminum and potassium. This material is somewhat less refractory than silica, and is incorporated for the purpose of imparting stability to, and increasing the translucency of, the compound.

Kaolin. Kaolin is the hydrated silicate of aluminum. This is a very fine grade of clay, and is a most essential ingredient, being incorporated for the purpose of imparting stability of form by holding the particles together, and thus facilitating the moulding and carving of the mass into the desired shape.

"Flux." The "flux" is usually composed of the carbonates of the alkaline metals, sodium and potassium, though in some classes of compounds the oxide of lead is also much used.

The quantity and nature of the "flux," and the manner of its incorporation determines the fusibility of the former refractory ingredients, and the tensile strength, or resistance to fracture, of the mass when all are fused together.

Coloring Matter. The coloring matter employed for the purpose of imparting the required variations of shade must necessarily be more or less *high fusing* in character, in order that the color, or tint, may not be dissipated, or burned out, in the fusion of the compound.

While the coloring matter itself has practically no influence upon the fusibility of the compound, the color imparted is, however, materially affected by the degree of heat required. For this reason, metals, or metallic oxides, are used for this purpose, in which the basal shades imparted are, approximately, as follows:

Yellow,	Titanium.
Brown,	Iron.
Blue,	Cobalt.
Gray,	Platinum.
Pink (gum enamel),	Silver and tin in combination with gold (purple of cassius).

The colors and tints characteristic of the different "bodies" are produced by the use of these in various compounds, of equally varying proportions, but the exact formula and methods of procedure are of special interest to the manufacturers only, and are usually more or less carefully guarded by them.

"High" and "Low" Fusing "Bodies."

The several varieties of "body" now prepared may be classified into two distinct grades—the so-called "high" and "low" fusing, with the line of common distinction between them being based, approximately, upon the fusing point of pure gold.

Comparative Advantages.

An intelligent analysis of the comparative qualities and advantages of the two classes of "body" demands a more or less limited familiarity with the composition of these compounds, and with the characteristics of their respective ingredients.

Silica being the most refractory and infusible substance, it might be commonly supposed that a "body" capable of being fused at a lower temperature than another would necessarily contain less of this ingredient and more feldspar and kaolin in proportion.

Such an assumption would be correct if the "flux" played a less conspicuous part in the reduction, but the same relative formula of the three basal ingredients may be used, and yet the fusing point of the resulting compound be regulated by the proportion of "flux" subsequently added to this formula.

But as a "body" must possess sufficient inherent strength, integrity and stability to offer a high degree of resistance to fracture, and must possess translucency, and absence of opaqueness, an *adequate* proportion of these three basal ingredients seems essentially necessary, since each has its place and purposes in the compound, as previously indicated.

This being apparent, if the fusing point is then regulated or controlled by the proportion of "flux," and it is conceded that the latter does not impart to the compound the highest degree of strength possible, in the light of our present knowledge it seems reasonable to deduce that, when a sufficient proportion of "flux" to reduce the fusing point of these refractory materials below a certain point is incorporated, the maximum degree of strength possible is not imparted to, nor obtained in, the product.

It, therefore, seems evident that when a maximum degree of strength is to be obtained, such as is required in the construction of crowns, or bridges, where at best the friable material is to assume the full stress of mastication, by direct contact, the compound which will best serve the purpose must be one possessing the integrity and stability imparted by the three basal ingredients to a degree not entirely destroyed by the incorporation of too great a proportion of "flux."

Shrinkage. All porcelain compounds *shrink* in fusing in proportion to the degree of their fineness of texture, and the quantity and nature of the "flux" used; and the degree of shrinkage adds to the difficulties incident to their manipulation with certainty, accuracy and expediency.

The "high" fusing compounds shrink from ten to fifteen per cent, while the "low" fusing range from the latter point up to 25 per cent, and some of the *glass* or extremely low fusing "bodies" which contain lead in large proportions even greatly exceed this. There is never any indication for the use of the latter, however, because of their minimum strength, and of their invariable tendency to discolor in the mouth, which may be attributed to the presence of the lead.

All of the compounds are more or less porous, and hence translucent, in proportion to the degree of fineness to which they are pulverized before fusing. Hence, as the lower fusing "bodies" are always reduced to a much finer texture in their preparation, they possess a greater density of structure.

This increased density, however, is due to the more homogeneous coalescence of the particles as a result of the more thorough admixture of the "flux," and is gained at the expense of translucency and stability, since the "flux," beyond a certain proportion, does not add integrity to the mass, but, on the contrary, increases the shrinkage, friability and tendency to globulate in fusing.

The degree of shrinkage is a very objectionable feature in this work, where so large a quantity of body is used, because the resistance to the *contraction* which takes place in the lower fusing "bodies," and which resistance is offered by contact with facing and cap, induces a tendency to fracture which greatly diminishes the strength.

A summary of the apparent disadvantages to be found in the "low" fusing "bodies" thus consists in their degree of *contraction;* their *diminished strength and translucency,* and their *lack of stability of form and color.*

These features also make their manipulation with accuracy and certainty more difficult, particularly for the inexperienced, because of the necessity for shutting off the heat at the precise degree at which the

proper fusing point is reached, in order to avoid a dissipation of the color, and a loss of the desired form, as a result of their great tendency to become spherical immediately following the definite and exact point of fusion.

For these various reasons, the use of the "low" fusing, or so-called "enamel bodies," or those which contain a large enough proportion of "flux" to reduce their fusing point below that of pure gold, and to decrease the stability of form and color, which are imparted largely by the three basal ingredients, cannot be considered at the present time, as being conservatively reliable for this special class of work.

Furthermore, a series of comparative tests for crushing and tensile strength of most of the various "bodies" now prepared, as conducted by Dr. J. E. Nyman, seems to prove conclusively that the most useful and reliable compounds for this class of work are to be found among those which fuse between 2,100° and 2,500° Fahrenheit, with the pyrometer gauged by the fusing point of pure gold, as being 2,016°.

Fusing Points.

The following table gives the approximate fusing points of most of the various bodies now in common use, as well as of the different makes of teeth, as compiled by Mr. J. F. Hammond, and Dr. W. A. Capon, in the Hammond Electric Furnace:

"Body."	Current.	Rheostat.	Time.	Tem. Fahr.
Jenkins's	110 volts.	1st step.	2 min.	1,544
Ash's Low Fusing	110 "	1st "	2 "	1,544
Ash's High Fusing	110 "	4th "	2 "	1,904
Moffitt's Porcelain	120 "	2d "	2 "	2,047
Brewster's Enamel	110 "	4th "	2 "	2,084
Consolidated's High Fusing	110 "	5th "	2 "	2,192
Whiteley's Porcelain	110 "	5th "	2 "	2,210
Brewster's Found Body	110 "	5th "	2 "	2,300
Close's Found Body	110 "	5th "	2 "	2,300
White's Porcelain	110 "	5th "	2 "	2,300
Parker's Body	120 "	5th "	2 "	2,586
Ash and Sons' Tooth Body	110 "	4th "	2 "	2,264
Sibley's Tooth Body	110 "	4th "	2 "	2,408
Dental Protective's Tooth Body	110 "	5th "	2 "	2,440
Justi's Tooth Body	110 volts.	5th step.	2 min.	2,440
S. S. White's Tooth Body	110 "	6th "	2 "	2,516
Johnson and Lund's Tooth Body	120 "	5th "	2 "	2,586
Luken's Tooth Body	120 "	5th "	2 "	2,606
Century Tooth Body	120 "	5th "	2 "	2,624
Consolidated Mfg. Co.'s Tooth Body	120 "	5th "	2 "	2,624

"Gum Enamel" "Bodies."

The compounds designated as "gum enamel" bodies contain a larger proportion of "flux" than basal bodies, and consequently fuse at a lower degree of heat, and possess less strength. Hence, when their use is indicated for the purpose of producing an artificial restoration of the gum color, the major portion of the contour of the piece should be made of the basal "body," and the "gum enamel" subsequently applied where necessary, and only for the purpose of imparting the gum color.

Previous to the application of the "gum enamel," the basal "body" to be covered by it should be fused until it presents a fairly smooth and well-vitrified surface. This is necessary, because it is not to be re-fused, and the maximum degree of strength will not obtain until its particles are well coalesced, and all shrinkage has taken place, and if this is accomplished at the time of the fusion of the "gum enamel," the color of the latter will likely be burned out or dissipated, owing to its greater fusibility, and its surface will present innumerable fractures, as a result of the further shrinkage of the base.

A new form of "gum enamel" has been introduced by Mr. Robert Brewster, of Chicago. This consists of a finely pulverized "body," which is mixed to the desired consistency with *oil,* and then painted upon the surface and fused, in the manner previously indicated, in connection with the use of "oil colors."

It would seem that this should prove to be the ideal method, because the same effect, and greater variations in shading, may be obtained, without diminishing the strength or increasing the weight or bulk of the finished piece.

Requirements for Crown and Bridgework.

A class of "body" possessing qualities adaptable to the maximum requirements for crown and bridgework will thus doubtless belong to the high fusing variety, and should be prepared in *one grade;* of a sufficient variety of colors, and pulverized *only* to a degree of fineness which will admit of being nicely carved. This latter feature is essential, because the shrinkage is increased and the fusing point decreased in any given compound in proportion to the degree of fineness in which it is prepared.

Those which are to be especially recommended are Brewster's "*Crown and Bridge;*" "S. S. White's;" the Consolidated Dental Mfg. Co.'s and Whiteley's products, all of which are supplied in neat and compact form, in a good variety of colors, quite adequate to the requirements for this work. While good results may also be obtained from the use of Brewster's "Inlay Bodies," which consist of *two* grades—"foun-

dation" and "enamel"—the best possible results are doubtless facilitated and afforded by the employment of *one grade* of material throughout the construction of the piece, and no difficulty will be encountered in obtaining the deisred *enamel surface* in any of these compounds, if they are fused to the proper degree of vitrification, without the use of any of the lower fusing, or so-called "*enamel bodies*" in conjunction therewith.

Manipulation of "Body."

That portion of the procedure which involves the manipulation of the "body" requires the most consummate judgment and skill, and, while it is largely true that the *strength* of the finished piece is much dependent upon the *metal construction* which forms the *foundation* for the porcelain, the degree of possible strength may be still further increased by skilful manipulation of the latter, or, as the converse is equally true, it may be diminished accordingly.

Preparation of Crown. When the crown has been taken from the investment, after soldering, it should *first be thoroughly cleaned* in 50 per cent sulphuric acid, in order to insure the removal of all remaining traces of borax or investment material which may cling to it, and which would be apt to interfere with the subsequent fusion of the porcelain; and the presence of borax is particularly objectionable, because it acts as a "flux."

The *surplus* ends of the *dowel* and *pins* should be ground down *smooth,* and so that they offer no obstruction to the contour, and afford no weakening of the porcelain, by extending or projecting into it, thus dividing it through the center, and all *sharp angles* should be nicely *rounded.*

These requirements are imperative, as the "body" should occupy all of the space possible. It will not fuse down close nor become attached to unclean or irregular surfaces, and in fusing will usually either draw away from, or fracture over, sharp angles as a result of the shrinkage.

When these precautions have been observed, the crown should be again treated to the acid bath, and then washed freely with clean water; if a *carborundum* stone has been used, care should be exercised to remove all particles which may cling to, or remain upon, the metal, or facing, as the presence of such particles will invariably cause a *discoloration* of the porcelain.

A close observation of these prerequisites, combined with *scrupulous care* and *extreme cleanliness* throughout the subsequent procedure, will materially increase the chances of securing successful results.

These results will also be greatly facilitated by confining the work

to a place especially prepared for such purposes, or to a portion of the work-bench which has been previously cleaned and arranged; all of the necessary instruments and appurtenances to be used should likewise be kept perfectly clean.

Selection of Color. When a suitable place to work is thus prepared, and the crown is ready for the application of the "body," its dowel should be grasped firmly between the jaws of a slide pin-vise, which will hold it securely during the building and carving (Fig. 197), and the proper color of "body" then selected.

This should approach the shade of the facing when one is used, or else of the color desired, as closely as possible, and may be accomplished with the use of the shade-guide, which accompanies the various makes of porcelain.

If the exact color cannot be matched, and some variation becomes necessary, a shade *slightly darker* than the facing should be selected, owing to the tendency to *bleach* somewhat in fusing. In this connection, it must be remembered that the *true color* of the porcelain compound will be obtained *only* when it is fused to the *exact* point of complete vitrifica-

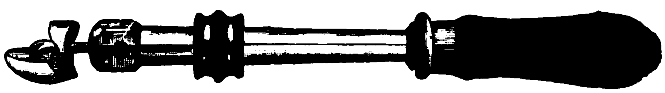


Fig. 197.

tion, and that it will become lighter in shade as it is carried beyond, or above, this point.

Mixing "Body." An adequate quantity of the "body," which corresponds in color to that selected on the *shade-guide*, should now be placed upon a clean porcelain or glass mixing slab, *distilled water* added, and then mixed thoroughly with a suitable spatula, until it assumes the consistency of thick cream. The water may be added in the most convenient and expeditious manner, by means of the "dropper," or "pipette bottle," such as is contained in many outfits for this work and which also serve to keep it pure and clean for subsequent use.

Sufficient water to insure the *desired consistency* and *thorough mixing* are quite essential, and any surplus of "body" is not wasted, because it may be replaced in its proper receptacle and used at another time.

Alcohol is sometimes recommended and used because of expediting the evaporation of the moisture from the compound, and thus facilitating

the carving of the mass, but this feature, because of usually being too rapid, is more often an objection than an advantage.

The addition of a small proportion of gum tragacanth to the water is also recommended as furnishing a means of adding to the cohesion of the mass after the evaporation of the moisture, and thus facilitating the carving and contouring, but its presence is objectionable, because it seemingly acts as a "flux" in the fusion of the porcelain, and is unnecessary, because the manufacturers usually incorporate a small proportion of starch in the compound for this special purpose.

The use of pure clean water is preferable. It should be *distilled,* however, because the presence of lime or organic matter may have an injurious effect upon the fusion of the porcelain.

Applying and Building.

In the manipulation of these compounds, it must be remembered that their tendency to *shrink* in fusing plays quite an important part, and governs the method of procedure to a large extent.

"One Grade" of "Body."

In the use of one grade of body, ***having the same fusing point,*** throughout the construction of the piece, the desired shape and contour for the finished crown should obtain for the first, or ***primary***

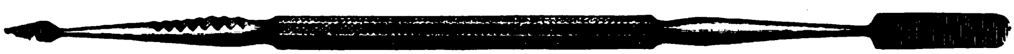


Fig. 198.

"bake," and yet it is *seldom possible* and ***never expedient*** to complete it in *one "bake,"* because of the shrinkage.

This latter feature necessitates *two,* and sometimes even more, "bakes," though the procedure is somewhat facilitated by forming the desired contour, even to the requirements of occlusion for the *primary* "bake," and the second or *final* application of "body" should then be made for the express purpose of *restoring that portion of the original form which has been somewhat changed by the shrinkage incident to the primary fusion* or "bake."

With the crown grasped firmly in the pin-vise (Fig. 197), and the body mixed to the proper consistency, a small quantity should be picked up with the point of a suitable instrument and first forced into the joint between cap and facing.

This may be facilitated by gently tapping the handle of the pin-vise, or by drawing a coarsely serrated instrument across it, and the procedure should be continued until the "body" is *thoroughly packed* into the space

A suitable instrument, designed by the author, for universal use in this work, and combining a spatula for mixing, a serrated shank for packing, and a pointed blade for carving, is illustrated in Fig. 198.

This feature of *packing* is imperative throughout the entire building up of the crown, as a means of insuring a high degree of integrity in the mass when fused, and of overcoming the tendency toward *porosity* in fusing, by insuring a close and *compact coalescence* of the particles.

As the building up progresses and each additional application of body is thus carried to place, and the contour formed, the procedure may be facilitated by absorbing the excess moisture, as it is brought to the surface, with a clean piece of linen or cotton cloth, or blotting or bibulous paper, until the approximate outline for the finished crown, *with a slight surplus,* obtains.

The latter part of the procedure may be accomplished with greater ease and facility by mixing the body to a *thicker consistency* after the joints and all small interstices are well filled.

When the required form has been obtained, the remaining moisture may be then more quickly evaporated by *passing the crown over a flame* until the mass is sufficiently dry to admit of being nicely carved.

The "body" should always remain moist enough, however, to be carved and trimmed without flaking or crumbling, and in the event of its becoming too dry to admit of this, it may be again slightly moistened by touching it with a wet brush.

In building up bicuspids and molars, after first filling the joint, a narrow strip of blotting paper may be conformed to the outline of the lingual portion of the band, and when held in place will serve as a matrix to hold the body in shape which thus facilitates the procedure.

Variations in Shading.

Variations of shade may be quite easily obtained by selecting the appropriate colors of body and mixing them separately. The color indicated for the base of the crown should then be applied, and built up to the desired point, when the other may be added without allowing the first to become completely dry.

Their use in this manner affords opportunity for blending them in fusing, and very artistic results are possible, particularly in those cases where the base should be yellow, or brown, and the incisal or occlusal end blue, or gray, in any of their variations.

Use of Oil Colors.

The use of the oil colors previously mentioned may also be productive of most excellent and artistic results. They should be *thoroughly mixed* to a thin consistency, with the accompanying *oil,* applied with a small brush, and separately fused.

Where it is desirable to produce a change in the color of the *facing,* these colors should be applied at the desired point on the *lingual surface,* and then fused, after which the "body" may be applied, as required, and the underlying color will show through the more or less transparent facing.

An appreciable change in the color of the porcelain forming the body of the crown may also be produced by applying and fusing these colors to the surface after the *primary* bake, when the final contouring may be made, the transparency of which, after fusion, will indicate the presence of the underlying color.

In simulating the characteristics of remaining natural teeth, *grooves, pits and sulci* may be colored or tinted as desired. As these colors fuse lower than the "body," however, this work can be done to the best advantage *after the crown has been otherwise completed;* and when they are used for such purposes on the labial or buccal surfaces of the facings, the desired inequalities should first be ground with a small carborundum stone in the engine, and this outline then properly colored or tinted, and the crown again fused until the colors become vitreous.

Contouring and Carving.

If not too dry, the procedure incident to contouring and carving the "body" is quite simple, but the artistic results will depend much upon personal equation and knowledge of the forms of teeth.

This may be easily acquired by a close study of natural teeth, and a good plaster model of a full typical arch will assist by serving as a guide in the execution of this work.

As has been previously stated, anatomically correct outlines are not essentially necessary, and artistic results may be obtained by simply so typifying the cusps as to distinguish between the right and the left, the upper and the lower teeth.

The requirements of occlusion with the opposing, and contact with the adjacent, teeth may be observed by trying the crown upon the model during the process of carving, and in order to prevent flaking the body or changing its given form, it may be carefully and *slightly* moistened with a wet brush previous to such trials.

For this reason, it is always necessary to have a good model to which the crown may be easily adjusted to position, as has been previously recommended.

In contouring and trimming the porcelain, it *must not overlap the band,* upon any surface, nor at any point, excepting along the *labial* or *buccal* surface, *where the facing mechanically retains it,* for without such means of retention it will invariably fracture or break away, leaving a rough, sharp, or irregular joint with the cap; and previous to placing

the crown in the furnace all particles of body which remain deposited upon, or overlapping, the surface of the facing, or which may have found lodgment on the inside of the cap, or on the under surface of the base, should be carefully removed with a clean, dry brush to prevent it from becoming attached in fusing.

The brushes used in this work should be of a good quality, such as are employed in water color painting, and the three useful sizes and shapes are illustrated in Fig. 199. The largest size should always be kept dry and used only for smoothing up the work, while the medium

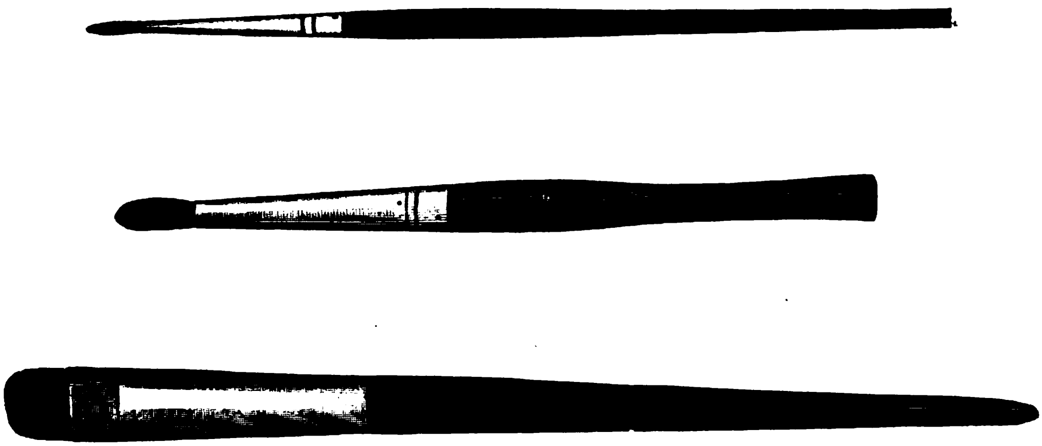


Fig. 199.

Fig. 200.

size should be employed for the purpose of moistening the "body," when necessary, and the smaller one only for painting, or deepening the finer lines in carving.

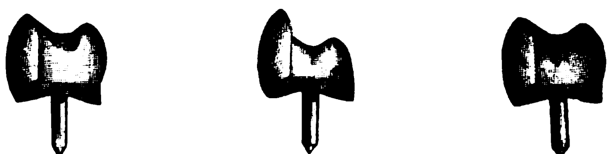
A very convenient form of simple carving instrument, designed by Mr. Robert Brewster, is illustrated in Fig. 200.

In trimming the body, the allowance of a slight surplus is demanded by the shrinkage, but the exact extent may only be ascertained with accuracy by a familiarity with the compound used, as all vary considerably in such properties.

The crown, when the body has been trimmed, and carved, and when ready for the *primary* "bake," is illustrated in Fig. 201 A.

Primary "Bake." When this desired form, and blending of color, have been obtained, the crown should be placed in the furnace and "baked" until the body becomes *slightly vitrified,* and the *particles well coalesced,* but its surface *should not be highly glazed* at this time.

This degree of fusion, or vitrification, is preferable to the so-called *biscuit* bake, commonly advocated, because of the desirability of securing a maximum degree of shrinkage in the primary fusion, but the surface should not be allowed to become *smooth* and *vitreous* at this time, because the second application of the body will not adhere so well to it. Fig. 201 B illustrates the appearance of the crown after the "primary bake," and indicates the degree of shrinkage and consequent change of form which takes place.



a b c

Fig. 201.

Final "Bake." For the final "bake," the crown should be again adjusted in the pin-vise and the "body" thoroughly mixed, *to a thin consistency, and first worked well down into every crevice and fissure* caused by the shrinkage, and then applied over the surface until the desired contour has been obtained, when it should be fused to the required degree of vitrification for the finished work, which is illustrated in Fig. 201 C.

If the crown comes out of the furnace after this "bake" presenting an irregular or broken surface of porcelain, such places should be filled with "body," and again fused, though if the proper precautions are observed, this will seldom be necessary.

"Foundation" and "Enamel" Bodies. When two grades of "body" which fuse at different temperatures, such as the so-called "foundation" and "enamel bodies," are used, the requirements are somewhat different from those indicated for one grade of body, because, if the desired contour of the crown is obtained in the primary formation and fusion, it will be difficult to manipulate the "enamel" body for the final bake, as it will necessarily need to be applied so thinly over the surface of the "foundation" body as to preclude any

carving, and increase the tendency to flake off, or become detached in places, before fusing.

Hence, where it is desirable to use two grades, the higher fusing, or "foundation," body should be applied first, only in quantity sufficient to indicate the desired form, as illustrated in Fig. 202 A.

This should be fused and the lower fusing, or "enamel," body then applied, trimmed and carved as desired (Fig. 202 B), and then fused.

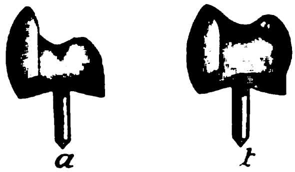


Fig. 202.

The increased quantity of the latter body and its greater shrinkage demands an allowance of more surplus than would be necessary if the same higher fusing body were used throughout.

Precautions Incident to Fusing.

No portion of this work is of more importance than the "baking" or fusing of the body, because the *strength* of the porcelain, and its true color, no matter to which class it belongs, are entirely dependent upon its being properly fused.

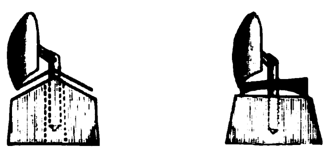


Fig. 203.

Supporting Crown in Furnace.

When the crown is ready for the furnace, it must be adjusted to a suitable form, which will *accommodate the dowel, support the base of the crown* by allowing it to *rest firmly and evenly,* and which will sustain it in a perpendicular position while in the furnace.

Whilst platinum trays were first used, and are even now occasionally recommended, for this purpose, their employment is objectionable because crowns not infrequently become attached to them in fusing, and

in the subsequent detachment the porcelain may be checked, or the shape of the band altered.

This attachment may be due to the re-fusion and flowing of a surplus of the pure gold, when such is used in soldering, or to an excess, or the over-fusing, of the porcelain, but whatever the cause, may be precluded by the use of supports made of *fire-clay* or chalk, of suitable form.

The proper adjustment of a crown with and without a band, to the style of support indicated for each, is illustrated in Fig. 203.

Such supports may be made by moulding a good grade of fire-clay to the desired shape, and "baking" it; or may be procured in various designs to meet the equally varying requirements of practically indestructible material from many of the manufacturers of furnaces and "bodies."

Useful designs for this purpose are supplied by Dr. R. C. Brophy, of Chicago (Fig. 204), or may be made by trimming down a piece of ordinary blackboard chalk to meet the requirements of the case.

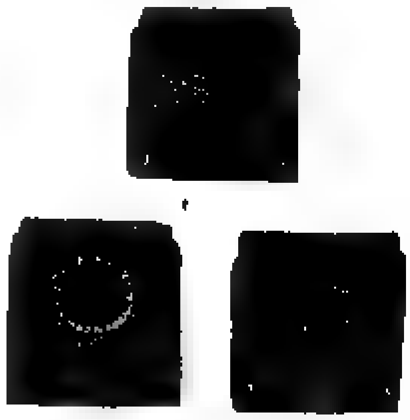


Fig. 204.

The latter is composed of compounds of magnesium and calcium, which are practically infusible, and being very inexpensive, it is quite useful. Such supports will serve the purpose nicely for individual fusings and may even be used two or three times before the form is lost.

Placing Crown in Furnace.

In placing the crown in the furnace, it should be observed that the dowel does not extend entirely through the perforation for its accommodation in the support, so as to bring its end in contact with the floor of the muffle; and that the facing does not touch the dome or sides of the latter, as such contact in either instance will invariably result in a fracture of the facing, due to too rapid heating, or uneven expansion.

The crown should be held in a perpendicular position, if possible, in order to prevent any change of form which might be induced by the influence of gravity, when the mass is in the fused state; and the body should always present toward the opening or door of the muffle, so that it may be closely watched while fusing. This latter feature is of

special importance, because if the body is not visible to the eye, portions of it may flake off unnoticed during the heating of the case, and necessitate a subsequent bake, to avoid which it should always be heated carefully and watched closely during the fusing.

Heating Furnace. As a matter of expediency, the heating of the furnace should begin immediately preceding, or during, the building up of the crown, so that the muffle will be thoroughly, but not excessively, heated when the crown is ready for the baking.

When these precautions have been observed, the support carrying the crown should be placed near the opening of the heated muffle and allowed to remain for a few moments, in order to become *thoroughly dry* before it is placed inside of the furnace. This will preclude *blistering* the surface of the "body," or the displacement, or flaking, of particles from the crown, as a result of the expansion of the remaining moisture, which would be induced by too rapid heating.

In placing the crown in the furnace, it should be carried to a position as nearly in the center of the muffle as possible, or to that point where there are the greatest number of heat units. For the reason that this heat area varies to a considerable extent, it is seldom advisable in the smaller crown furnaces, with the opening in one end only, to fuse more than one or two crowns at a time, and if each is to be baked *uniformly,* they must be placed *crosswise* in the muffle, in order to get such a result, as the temperature decreases toward the door or opening.

Fusing.

In the fusing of porcelain "bodies" the physical process involved constitutes changing the powdered *granular* mass into a *vitreous* substance, which is then more or less homogeneous in proportion to the thorough admixture of the "flux," or the degree of complete coalescence of all of the particles.

Hence the proper fusing of these compounds is largely a matter of experience. In the lower fusing "bodies" the proper and desired degree of vitrification may be easily and definitely ascertained by observing this physical change as it is produced by the application of heat. This is also true of the higher fusing bodies, but the greater degree of heat required, and the consequent incandescence within the furnace makes it more difficult. The eye may be trained to a degree of familiarity with the physical changes, however, which will enable the experienced operator to more or less easily distinguish the disappearance of the rough or *granular* surface, and the appearance of the smooth, glassy or *vitreous* surface even in the, at first, somewhat trying glare of the incandescent heat, without

greatly endangering or impairing the sight, because it is not necessary to bring the eyes close enough to the furnace to be seriously affected by the heat.

Smoked or colored glasses may be found useful in this connection, and during the fusing of the "body" the furnace may be occasionally opened for this purpose without danger of fracturing the facing, because the volume of heat is too great to admit of the ingress of cold air.

While everyone desiring to do this class of work in the most accurate and successful manner should cultivate this degree of familiarity with the characteristic appearance of the "body" in the various stages of vitrification, it can only be acquired through experience. When the crown is properly placed in the furnace the heat should be gradually increased until a bright red color is produced. This may be done by degrees without observing the crown itself, but from this point on the latter should be watched closely so as to observe when the rough and granular surface becomes smooth and vitreous, which to the experienced eye is indicated by the degree of incandescence, and as soon as a *glassy* appearance has spread over the entire surface of the porcelain the heat should be immediately turned off.

Tests.

Many tests for determining the exact heat required to properly fuse the various "bodies" have been suggested. Alloys of platinum and gold prepared in various proportions with a view to having the test metal melt at the same point as the porcelain would greatly facilitate the fusing, but as this requires a special alloy for each kind of "body," and as these are not on sale ready prepared at the present time, it involves considerable experimentation to apply this method.

Pure Gold.

Pure gold may be used with some degree of facility, and its use is recommended as a guide to the beginner and an aid even to the experienced. A pellet of foil, or a globule *previously flattened* on the anvil for each fusing may be placed alongside of the crown in the furnace. When this fuses, which may be noted by its assuming globular form, the beginning of vitrification of nearly all of the higher fusing bodies will be indicated.

From the moment of the fusion of the gold to the required or desired point of vitrification of the porcelain, *time* is the only reliable test other than the eye, and as this varies with each furnace and class of body, it must be previously more or less definitely ascertained by experimentation.

The separate fusing of several cubes of the "body" used will enable one to ascertain the exact time after the fusion of the pure gold with approximate exactness. When the desired point of fusion has been

reached the heat should be immediately shut off, and the crown allowed to cool slowly until a low temperature obtains, when it may be removed from the furnace. Whilst immediate removal as soon as the heat is turned off, and then placing the crown in a *cooling muffle,* or in some convenient receptacle where the air will be excluded until it is cold, is sometimes recommended, and is permissible in emergencies, the furnace itself affords the best "cooling muffle," and the slow and gradual cooling of the piece seems to "*temper*" or anneal the body, and thus render it less brittle.

Porosity. Porosity of the body after fusing is one of the chief causes of failure in this work. When this occurs it may invariably be attributed to one of three causes,—the use of a surplus of pure gold in soldering; imperfectly "*packing*" the body in building up the crown, or *overfusing* it in the furnace.

Fig.205.

An excess of pure gold which occupies space and which space subsequently becomes a vacuum when the gold is fused in the furnace and absorbed by the platinum, can be avoided by using a minimum quantity of, and properly fusing the gold during the process of soldering.

There is no excuse for imperfect "packing" if the precautions indicated are observed; and "overfusing," which will be denoted by the beginning of a change of form, will not occur if the case is watched closely while in the furnace, or the time test is accurate. This is extremely essential to the success of the finished work, because overfusing burns out, or dissipates, the color, and destroys the integrity of the material, no matter to which class it belongs.

When the final baking has been completed the exposed lingual sur-

face and entire edge of the platinum band should be smoothed with sand-paper and polished with cuttle-fish disks, and the crown then tried to place and mounted.

Furnaces.

Several varieties of furnaces are now made for porcelain work in which three sources of heat production are successfully employed,—electricity, gasoline and gas.

Electric Furnaces. The electric furnaces, or "ovens," in which the heat is obtained by the passing of the current through a close coiling of small platinum wire slightly imbedded in fire-clay without contact, or wound around the out-

Fig. 206.

side of a thin muffle, possess the advantages of purity, range and control of heat, and of cleanliness and the absence of noise or odor.

Owing to the absolute purity of the heat thus obtained any possible danger of discoloring the porcelain from "gassing," is eliminated; and for all of the combined reasons mentioned the use of the electric furnace is recommended wherever it is possible to secure suitable commercial current, such as is supplied for incandescent purposes.

Of the several makes of these furnaces especially constructed for small work, such as single crowns and small bridges, those known as the

"Hammond," "Custer" and "Pelton" are to be recommended as being neat, compact and serviceable, as are also the "Roach" automatic, and the "Price" and "Garhart" Pyrometer designs.

These furnaces include a rheostat in serial connection with the muffle or "oven" and forming the base of the furnace, and they work equally well on either the direct or alternating currents of the same voltage.

While the two former furnaces are made in three sizes, the Hammond No. 2, Fig. 205, and the Custer No. 5, Fig. 206, will be found to be the most convenient size for this special work, though there is no objection to using the larger sizes which are designed for continuous gum work when several crowns at one time, or large bridges, are to be "baked."

As the larger sizes require more time in fusing, it is more expedient to use the smaller ones for crown work. The *opening* in the latter, however, is in *one end,* hence the heat is greatest as the back wall of the muffle is approached. For this reason, if more than one piece is "baked" at the same time, they must be placed *crosswise* and *not lengthwise* with the muffle, in order that the porcelain may be uniformly fused.

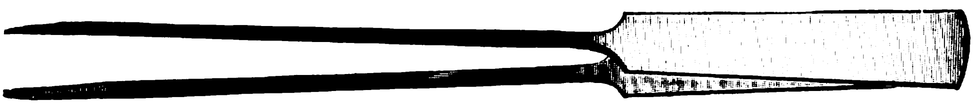


Fig. 207.

When the piece is adjusted in the heated furnace it should be allowed to remain for a few moments, and the lever controlling the rheostat then gradually and consecutively pushed from button to button, with an interval of from one to two minutes between each. When the last or highest step required is reached, the case should be closely watched until the body is properly fused, or timed from the fusing of the pure gold, when the lever should be immediately reversed, and the piece allowed to cool more or less slowly before removing.

Convenient pliers of special design, suitable for inserting or removing the support containing the piece, are illustrated in Fig. 207, but, while these are also very useful for solder work in general, because of their length, a special pair, kept perfectly clean, should be used for this work. In using pliers in the furnace, however, when the current is turned on care must be exercised to avoid bringing them in contact with the wires, and thus possibly fusing the latter or "burning out" the furnace by short-circuiting.

Fig. 208.

Fig. 209.

Gasoline Furnaces. Where it is not possible to secure commercial electric current, and for reasons of possible emergency and economy, the gasoline and gas furnaces, as now made, will serve the purpose nicely, and when properly used, will furnish adequate heat.

While it is true that such facilities do not afford the same degree of absolute purity of heat, there is but little danger of "gassing" or discoloring the porcelain, in their use, if the continuity of the muffle is perfect.

The gasoline furnace is preferable to gas because the heat production is aided by means of a pneumatic pump and the one manufactured by Dr. R. C. Brophy, of Chicago, Fig. 208. especially designed for crown

Fig. 210.

and bridgework, is adequate to the requirements in every respect. This furnace is made in two styles, one with a very thin fire-clay muffle, and the other with a nickel muffle, both of which are quite serviceable, with the preference perhaps slightly in favor of the former.

The Turner gasoline furnace, Fig. 209, manufactured by the Turner Brass Works, of Chicago, is similar in design (except that the nickel muffle is exclusively used), and is perhaps equally as effective.

In the use of these furnaces they should be started and well heated before the work is placed in the muffle, and the piece should first be thoroughly dried and heated at the opening before being carried into the inside.

As the muffle opens from one end the same precautions indicated in connection with similarly constructed electric furnaces should be ob-

served, and when the work is finally adjusted to place, the opening should be closed as a means of confining the heat to the inside and preserving its purity.

The fusing of the porcelain may be known either by watching with the eye, or by gold and time test, as previously described, in which the "plug" closing the opening of the muffle may be frequently removed for the purpose of observation, and the same requirements incident to turning off the heat, and allowing the work to cool slowly should also be observed.

If the required heat is to be obtained with facility, the supply of air must not be allowed to become diminished, hence the pump must be used with sufficient frequency to maintain high pressure.

It is also necessary to watch the condition of the muffle in order that it may be replaced when the continuity becomes destroyed by disintegration, by which means the possibility of "gassing" the work will be largely overcome; and, the greater facility with which this may be done, together with the inclosed shelf at the opening of the muffle, for heating the work, and the larger size of the latter, constitute the main advantages of the first-mentioned furnace.

Gas Furnaces.

The gas furnace designed by Dr. R. C. Brophy, Fig. 210, may also be successfully used. As a supply of air sufficient to afford complete combustion with illuminating gas is needed, however, the employment of compressed air, or the use of the "bellows" becomes necessary, and in the absence of the former, the effort required is of course much greater than that in the use of gasoline. Where compressed air is available, this furnace is to be especially recommended.

The more or less objectionable odor which emanates from the use of gasoline, however, is overcome, but the noise produced by the combustion in each is one of the most unfavorable features in connection with the use of either of these furnaces.

Insertion of Gold Fillings in Artificial Teeth.

CHAPTER XIV.

Indications. Methods: Foil Gold, "Roman" Gold, In Combination with Backing; Procedure.

The insertion of gold fillings in porcelain facings employed in the construction of crowns and bridges is very often indicated as a means of simulating the remaining natural teeth, and thus observing, and complying with, the requirements of *harmony,* and with a view to and for the purpose of obtaining increased esthetic and artistic results, as has been previously mentioned.

Indications. In the construction of individual crowns for any of the anterior teeth, if the remaining adjacent natural teeth are more or less freely filled with gold, the crown should almost invariably carry one, and sometimes two, small approximal fillings; and in bridgework involving the upper anterior teeth, where the lower anterior teeth are likewise filled, the insertion of one or two small fillings in appropriate locations will often aid materially in detracting from the artificial, and adding to the natural, appearance of the work.

Such fillings should never be inserted, however, with a view of making the work conspicuous, nor for the exclusive purpose of additional remuneration, and should be no larger than necessary to effect the *harmony* and *legitimate deception* which may be thus indicated by the adjacent natural teeth.

Methods. The methods employed in accomplishing this work consist in preparing a retentive cavity and filling it with foil gold; in the use of liquid or "Roman" gold, which is painted over the desired area, and then *fired* in the furnace, in a manner similar to that employed in china decorating; and the construction of the filling as a part of the backing.

Foil Gold. In the employment of this method, which is perhaps the most generally used, and which affords the most permanent, expeditious and artistic results, a cavity, in the appropriate location and of the desired form, should be first outlined in the facing with a small fine carborundum-stone. (Fig. 211a.)

This outline facilitates the cutting or drilling of a cavity of the necessary retentive form and affords a definite marginal edge for the subsequent adaptation and finishing of the gold.

When so formed, adequate retention may then be secured by drilling a simple countersunk cavity of sufficient proportions in the center of the outlined area (Fig. 211b), or by cutting retentive grooves (Fig. 211c).

For the former purpose, which is more generally applicable to small cavities, an inexpensive diamond drill, to be used in the engine, is made by the S. S. White Dental Manufacturing Company (Fig. 212a), while the retaining grooves, which are best adapted to larger cavities, may be easily cut with a small copper disk coated with diamond dust, which is also prepared for this and similar purposes (Fig. 212b), or with the

a b c d

Fig. 211.

"cavity cutting" outfit manufactured by the same company, and which consists of a set of engine instruments of oval form, and graded sizes, and a cutting material composed of carborundum dust and glycerol.

While this latter method accomplishes the work nicely, it is scarcely so expeditious as the two former procedures, in the use of which the rapidity of their cutting properties is facilitated, and the danger of fracturing the facing is entirely eliminated, by the free use of oil or glycerine as a lubricant. This saves the instrument, and prevents the creation of heat otherwise induced by friction, which might cause fracture.

When the proper retention has been secured, the cavity should be thoroughly cleaned with soap and water and dried with alcohol and hot air, and then filled with small pellets of gold in the ordinary manner, and finished as usual (Fig. 211d).

While it is usually advisable to defer the insertion of such fillings until after the completion of the work, in order that any subsequent scratching or defacing of the surface may be prevented, it may frequently

become necessary, or seem desirable, to insert them before the construction of the work, or the assemblage of the parts.

This may be essential in bridgework constructed with gold to admit of placing the cavity in the desired location upon the approximal surface, and when here or otherwise indicated the procedure may be greatly facilitated by imbedding the facing in a base of modelling compound or sealing wax, as a means of holding it securely (Fig. 213).

In porcelain work, however, the procedure must necessarily be deferred until the piece has been finished, in order to preclude fusing the gold, and the same is likewise advisable in single crowns, for the reason mentioned, and in any event the preparation of cavity and insertion of filling should be done at the same time.

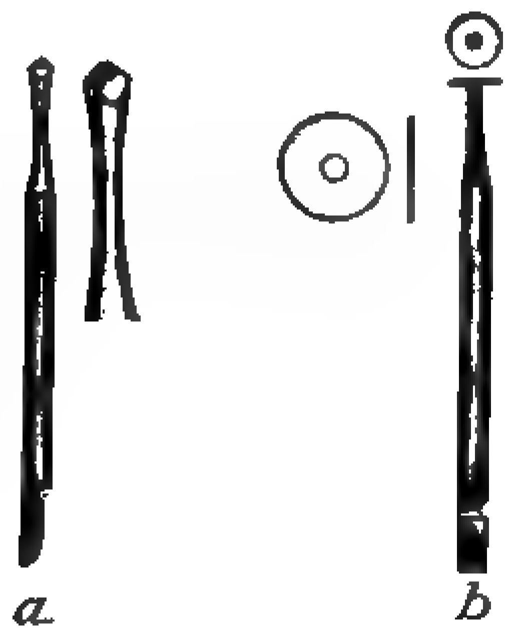


Fig. 213.

Fig. 212.

Roman Gold.

In the use of the so-called "Roman" gold, which is prepared for similar decorative purposes, and quite applicable to this, the cavity area should be first outlined, as indicated in Fig. 211a, and the gold then mixed into a paste of proper consistency and painted thickly over the surface, being careful to observe that it closely follows and evenly approximates the cavity margins.

The facing should now be placed near a flame, or close to the previously heated furnace, and allowed to remain until the gold has become *thoroughly dry*, when it should be placed in the furnace and "fired" until the gold fuses, which may be readily observed by its *vitreous* appearance.

After allowing to cool more or less slowly, the filling may be easily finished and polished with burnishers, or *fine* cuttle-fish disks, and the buff wheel.

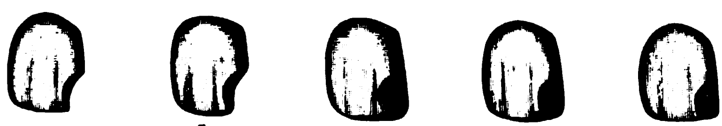
In gold work such fillings should be made *before* the final attachment of the facing to the metal parts, with solder, while in porcelain work the lower heat required to fuse the gold demands that they be made after the completion of the piece.

While this method affords artistic results, the objections to it lie in the fact that such fillings are likely to be less permanent, because of a tendency to flake and chip.

In Combination with Backing.

A method involving a less simple detail, and requiring more time, perhaps, but productive of very artistic results, is applicable to gold work, and consists of making the filling in combination with and as a part of the backing.

Its employment is indicated more especially, however, in simulating approximal fillings involving the incisal angle, which is sometimes desirable, and which would be more or less difficult by the other methods,



a b c d e

Fig. 214.

because of the limited opportunity afforded by the ordinary facing for securing adequate anchorage for such fillings.

Procedure.

When such a filling is indicated, or where it may be desirable to employ this method, the facing should be first ground to the proper and required adaptation, and then prepared for the reception of the backing, in the usual manner.

That portion of the porcelain which involves the location and area of the desired cavity formation and gold restoration should then be ground away on a *slight bevel toward the lingual side,* until a perfectly smooth marginal outline has been secured (Fig. 214a).

A backing of about 34 gauge pure gold should now be adapted to the facing, and burnished up well against the cavity margin, allowing a surplus of about 1/32 of an inch to project beyond the latter, and upon the incisal end (Fig. 214b). When this has been accomplished, a piece of 22 karat gold plate, 29 or 30 gauge, should be adapted to this, extending from the pins to the incisal end, and projecting out to the original

outline of that portion of the facing which has been destroyed (Fig. 214c).

This forms a matrix, indicating the desired formation of the filling, and the two backings should now be removed and united with solder in the manner previously described in connection with "re-enforced backings." Their detachment from the facing without danger of changing the shape of the thinner one is made possible and facilitated by the slight lingual bevel given to the cavity wall in its preparation.

When their union has been effected, the matrix formed by the two backings should be filled with 22 or 20 karat solder until the desired contour obtains (Fig. 214d).

This should then be adjusted to the facing, securely attached by bending the pins, and finished with files, stones and disks until the adaptation of the backing and the contour of the filling are as desired (Fig. 214e), when the piece may be completed and finished in the usual manner.

In securing the desired contour of the filling with solder, a high karat must, of course, be used, because of the susceptibility to discoloration, and clean flux must be applied to avoid a pitted surface.

In flowing the solder, it is also well to observe the precaution of fitting a piece of gold or platinum wire or plate into the matrix before the procedure, as this insures a preservation of the adaptation of the pure gold to the cavity margin, which otherwise might be somewhat changed by shrinkage, if solder alone be used.

Finishing, Polishing and Mounting.

CHAPTER XV.

Finishing. Polishing: Facilitating Procedure. Precautions. Gold Plating. Cyanide Solutions, Prepared Solutions. Mounting: Preliminary Adjustment; Temporary Mounting; Permanent Mounting; Use of Cement; Procedure; Dowel Crowns, Shell or Telescope Crowns, Insuring Accuracy of Adaptation to Root, Two or More Crowns, Therapeutics. Use of Gutta Percha; Advantages, Disadvantages, Procedure; Dowel Crowns, Shell or Telescope Crowns, Final Mounting. Combining Cement and Gutta Percha; Procedure. Variations of Procedure; Use of Chloropercha; Use of Shellac and Sandarac; Rubber Tissue. Final Precautions. Removing Crowns Mounted with Gutta Percha.

The finishing, polishing and mounting of crowns, while almost equally as important as any other special portions of the work, are, nevertheless, quite often neglected or done in a more or less perfunctory manner, because of not being fully appreciated.

This should not be so in any single instance, for the reason that proper *finishing* and *polishing* adds materially, not only to the artistic appearance, but also, and particularly where gold is used, to the increased hygienic condition presented in the finished piece; and successful *mounting* has much to do with the degree of comfort and permanency of the operation.

Finishing.

When the case has been removed from the investment, it should first be treated to the acid bath for a sufficient length of time to insure the thorough removal of all products of oxidation, and of all particles of investment material and "flux." After this has been effectually accomplished, the acid should be thoroughly removed by washing freely with clean water, and the case then finished in accordance with the requirements, and with the maximum of artistic possibilities to which gold and platinum are so highly susceptible, as is evidenced in the jeweler's art, and in jeweler's products.

The primary efforts in finishing should consist in obtaining the required contour; the desired obliteration of all joints, and evenness and

smoothness of the surfaces; and should include removing, or diminishing any undesirable or unnecessary display of metal upon any surface. Owing to the small size of the piece, this may usually be best accomplished with small carborundum stones, of coarse and medium grit, used in the engine. These should be followed with emery or sandpaper disks of medium grit, and subsequently with very fine, or cuttlefish, disks, until every scratch is removed, and the surfaces are perfectly smooth.

A more finished and artistic appearance may be given to the lingual surfaces of anterior crowns with gold backings by making an effort to reproduce the natural shape and form of this surface in the gold (Fig.

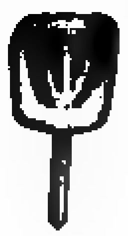


Fig. 215.

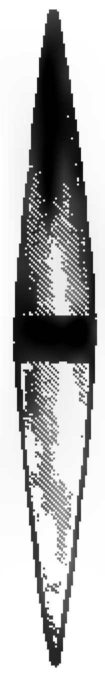


Fig. 216.

215), which may be easily and quickly done with a knife-edge carborundum stone, and plug-finishing burs.

Polishing.

This should then be followed by highly polishing the metal with felt and brush wheels on the lathe. The primary polishing should be obtained with a thin-edge felt wheel (Fig. 216) and moistened pumice stone of medium grit; and the wheel should be previously soaked in water, so that it will absorb and carry the pumice stone with it during the procedure.

When the desired smoothness of surface has been thus obtained, the final polishing should be given first with a stiff brush-wheel (Fig. 217a), used with the pumice stone, and then with moistened whiting, or precipitated French chalk; and this should be followed with a *soft* brush-

a

b

c

Fig. 217.

wheel (Fig. 217b) and whiting, and finally with a cotton "buff" wheel (Fig. 217c) until a highly polished and mirror-like surface presents

Such a finish requires but little effort and but a few moments' time and is always indicated because of the more artistic appearance of the work, and of its being thus rendered more hygienic. The more highly the surfaces of metal are polished, the less susceptible are they to discoloration, and the more permanent and self-cleansing is the finish, because less opportunity is thus afforded for the subsequent attachment of accumulations in the mouth.

Jewelers' rouge and various other polishing compounds are often advocated and are employed with the "buff" wheel for the final polishing, but nothing seems to produce better results than whiting, if properly

Fig. 218.

Fig. 219.

used, as indicated; and the reddish color imparted by rouge to the metal, together with the discoloration of the fingers incident to its use, are more or less objectionable.

Facilitating Procedure. As single crowns, and particularly those of the "shell or telescope" variety, are somewhat difficult to handle while polishing, various styles of "crown-holders" have been devised for facilitating this part of the work.

The most ingenious and perhaps universally useful of these instruments is the one known as Fahey's Ideal Crown Holder, manufactured by the Dental Specialties Company, of Chicago (Fig. 218). This is adaptable to almost any size of crown, because of one blade being removable;

and, the spring being adjustable, it holds the crown securely with little or no danger of distorting its shape.

A similar device which is also useful for this purpose is known as the "Burgess" crown holders, and is shown in Fig. 219.

The filling of the crown with compounds of sealing wax, and then inserting a piece of wood into it while it is hot, is sometimes recommended, but is objectionable because of the difficulty of removing the compound after the polishing is completed; and the fitting of the end of a piece of wood of suitable length to the interior of the crown is likewise a poor method, because of the possible distortion of the shape of the band in so doing.

While dowel crowns are not quite so difficult to handle in the polishing, the use of one of the pin vises previously recommended may sometimes be found convenient.

Precautions. Although it is scarcely possible to give too high a polish to the exposed surfaces of metal which are to be permanently fixed in the mouth, it is, however, quite possible, and indeed sometimes quite easy, to polish through the thinner portions of a crown in the use of disks and felt wheels; hence, in polishing, extreme care should be exercised to prevent such a mishap, as well as to preclude any unnecessary thinning of such parts.

Gold Plating.

An increased artistic effect, and a more permanent finish, may be obtained by subjecting the piece to the electroplating process, *after it has been highly* polished. This imparts a uniform rich yellow color to all metal surfaces and affords a surface of pure gold which is more or less permanent, and which is not so easily attacked and discolored by the chemical action of the secretions.

Cyanide Solution. Solutions for this purpose may be made by dissolving fifteen grains of the chloride of gold in a porcelain or glass vessel containing about four ounces of distilled water, and then adding to this a like quantity of water into which about thirty or forty grains of pulverized potassium cyanide has also been previously dissolved in a similar vessel. This is known as the "*cyanide solution,*" the approximate formula for which, as generally employed, is as follows:

Chloride of gold	gr. xv.
Cyanide of potassium	gr. xxx. to xl.
Distilled water	oz. viii.

A small ordinary "primary" or "dry cell" battery may be used, and the work to be plated should be attached to the *negative* pole and then

suspended in the solution, with a piece of thin pure gold plate likewise suspended from the *positive* pole, *avoiding contact* between the two.

If the piece is *well finished* and *highly polished,* and then washed with bicarbonate of sodium to remove all traces of organic matter, and then fastened to the pole by so coiling the wire as to have a well-distributed contact over the surface of the metal to be plated, a few minutes' immersion in the solution will afford the desired result, after which it should be again highly polished with the "*buff*" wheel.

Prepared Solutions. Solutions which may be used without a battery are prepared for this purpose, and while they seem to afford good results, the deposit of gold is probably not so heavy, and hence not so permanent, and the solution can only be used until it becomes inactive.

In their use a sufficient quanity of the solution should be placed in a porcelain or glass vessel and heated until *warm,* and the work then attached to a strip of *pure zinc* and immersed therein.

Moderate heat and slight agitation will effect the desired result in a few moments, and the permanency and effectiveness of the solution may be increased by suspending a small piece of pure gold plate on another zinc strip hooked over the edge of the vessel so that the gold is immersed.

Mounting.

No portion of the entire procedure incident to the construction and application of the work is of more importance than the detail involved in its secure and permanent attachment to the root.

In order that such a fixation may be secured with reasonable facility, the medium used must possess sufficient plasticity to admit of the proper and accurate adjustment of the crown, and to completely fill the intervening space between it and the root, and must then afford a substantial and more or less insoluble and impervious union between the two.

Preliminary Adjustment. Previous to any effort toward permanent mounting, the crown should *always* be adjusted to position on the root, as a means of ascertaining with absolute certainty that it meets with all the requirements of fit, occlusion, etc., as well as to admit of making any changes in its form or shape which may be necessary, and of subsequently repolishing, which can never be done so well after permanent fixation is secured.

The adjustment may be greatly facilitated in so far as discomfiture to the patient is concerned by slightly moistening the interior of the band with 95 per cent carbolic acid, or by *carefully* bathing the gum surrounding the root with a two or a four per cent solution of cocaine just previous to inserting the crown.

The former procedure is perhaps the more simple, equally effective and less dangerous one, and usually affords sufficient anesthesia of the parts to admit of the subsequent permanent mounting without any appreciable discomfiture; and any possible injury to the tissues from the escharotic effect may be overcome by bathing them with alcohol as soon as the crown is forced to place.

The driving of the crown to position is never warrantable or necessary if the adaptation is anywhere near correct; anterior crowns can usually be forced to place with the fingers, and a firm closure of the jaw will aid in adjusting those on the posterior teeth. In the event of the absence of occluding teeth, a small flat piece of wood may be used to advantage here, as indicated in the fitting of bands.

When it has been observed that the adaptation is correct, the crown should be then removed and mounted, as the patient should never be dismissed, *no matter how firm it may remain in place at first,* without the presence of some medium of attachment which may preclude its becoming loosened, and any possible distortion of the fit or shape which might result therefrom in wearing, not overlooking the danger of swallowing it.

Temporary Mounting.

In the event of permanent mounting being contraindicated for a time, the crown may be temporarily mounted in a manner which will admit of its being worn without danger of becoming loosened or distorted in shape, and of its being removed with facility whenever necessary.

When such a procedure may for any reason be indicated, *temporary stopping* will serve as a sufficiently substantial medium to afford attachment from sitting to sitting, or for a few days' duration, but it does not possess sufficient integrity to be reliable for any great length of time.

In its use, the root should be dried with alcohol and hot air, and a sufficient quantity *thoroughly heated* and placed inside of the band, and the crown then quickly forced to place, after which it may be chilled with a spray of cold water directed upon the crown, and the surplus then trimmed away.

Crowns so mounted may be easily removed with a pointed instrument, hooked over the edge of the band, as heat higher than the temperature of the body is scarcely ever necessary to destroy or reduce the adhesive property of this material, which accounts for its not being reliable for more permanent usage.

Permanent Mounting.

The requirements of a permanent mounting are best obtained at the present time in the use of the oxyphosphate of zinc cements and gutta

percha. Amalgam was formerly used to some extent but has been practically abandoned in view of the greater facility with which either of these may be successfully employed, and the absence of adhesive properties.

Use of Cement.

Cement is perhaps the more generally employed because of the facility with which it may be manipulated, combined with its adhesive properties and inherent strength when moisture is excluded.

Fig. 220.

The disadvantages incident to its use are the temporary irritation to the tissues in mounting; the possible more or less permanent irritation which may be induced by hidden particles accidentally left in contact with the gum after mounting; its susceptibility to dissolution when exposed to the action of the secretions; its possible shrinkage in crystallizing, and the extreme difficulty with which a crown may be removed, and particularly a dowel crown, when occasion demands.

Procedure.

When it has been ascertained that the adaptation is correct, and when the crown is ready to be permanently mounted, its inner surface should be cleansed with alcohol, and thoroughly dried with hot air.

The root should now be *rendered aseptic* by a careful bathing with carbolic acid, or by the use of pyrozone or hydrogen peroxide, or any good antiseptic, and then thoroughly dried with pledgets of cotton.

Thorough drying is *absolutely essential* and may be facilitated by precluding contact of the lips, cheeks, or tongue, with cotton rolls or pads, and then using alcohol or chloroform evaporated with compressed air, or warm air from the chip blower. The non-absorbent cotton rolls prepared

Fig. 221.

in various sizes and lengths by Johnson and Johnson are very convenient for such purposes. The use of these in the anterior part of the mouth is illustrated in Fig. 220, and if the root is in the posterior part of the mouth, a "mouth prop" adjusted in the opposite side to hold the mouth open will often be found very useful, and the cotton rolls may be effectively retained with a clamp adjusted to an adjacent tooth. Fig. 221.

A good reliable medium setting cement should now be mixed to a creamy consistency, which should, and can best, be done by an assistant, when possible, in order that the operator may confine himself to observing that the root does not become moistened.

Dowel Crowns. If the crown possesses a dowel, the canal, or canals, should first be thoroughly filled with the cement. This may be accomplished by using a root canal plugger and a pumping action, until the cement has been carried to the extreme ends. A cement syringe for this purpose has been devised by Dr. H. L. Cruttenden, but its use usually involves more time than is necessary or warrantable for such a simple procedure.

When the canal has been thus well filled, the dowel and interior of the cap should be coated or covered with a layer of cement, which, if done by the assistant during the filling of the canal, will greatly expedite the operation, and the crown should then be quickly and firmly pressed to its proper position on the root.

After becoming assured of its having assumed the proper relation, the patient may be requested to close the mouth until the cement has at least partially crystallized, the length of time required for which will be indicated by the surplus remaining upon the mixing slab. It is desirable that the first stages of the setting of the cement should be obtained under pressure. Therefore the operator should press firmly upon the crown with the finger or a piece of soft wood for at least five minutes.

The crystallization may be hastened somewhat by directing warm air from the chip blower upon the crown, and when sufficiently hard, all surplus should be carefully removed with pledgets of cotton, and a sharp-pointed explorer passed carefully around the band beneath the gum.

A ligature drawn through the interproximal space may further insure the removal of any remaining surplus at these points, which precautions are always advisable, because of the extreme irritation to the gum which is produced by such hidden particles after their complete crystallization.

Coating the outside of the band along the cervix with vaseline or oil just previous to mounting is recommended as a means of facilitating the removal of the excess by preventing its adhering to the edge or surface of the crown.

"Shell or Telescope" Crowns. In mounting the "shell or telescope" crown, the same detail is indicated, but as a larger quantity of cement must be placed in the crown, care should be exercised to have it cover all surfaces, and be devoid of air spaces, in order to insure the complete filling of the entire intervening space between it and the root. The proper quantity is governed, of course, by the length of the root which projects or extends into the crown.

As soon as the crown is forced to place, the mouth should be immediately closed and the occlusion observed, and when this is as it should be, which will be indicated by the normal contact of the adjacent oppos-

ing natural teeth, a roll of cotton should be placed between the crown and the opposing teeth, and a steady and firm pressure of the jaw in normal occlusion maintained until the cement has crystallized, in order to prevent any possible displacement.

The same precautions incident to the removal of all excess cement should then be observed with equal care, and before dismissing the patient it should be carefully and finally noted that the crown *does not occlude too hard,* as subsequent discomfiture will invariably result if this condition exists.

Insuring Accuracy of Adaptation to Root.

If any doubt exists as to the accuracy of the relation of the cervical edge of the crown to the periphery of the root, some means of insuring a close joint between them should be observed.

This may often be aided materially by slightly reducing the circumference of the edge of the band with curved or small, pointed pliers, just

Fig. 222.

previous to the final mounting, as it may have become somewhat enlarged, by stretching, in the fitting and preliminary trials.

The use of a smooth foot plugger adjusted to the automatic mallet may also be found useful, and particularly along the buccal edge, after the crown has been mounted; and the approximal edges may be brought into closer contact by inserting a small amalgam burnisher into the interproximal spaces, and exerting some little effort in this direction. Either a suitable burnisher, such as is illustrated in Fig. 222, or the foot-plugger, may often be employed to good advantage upon the lingual surface, but in the use of either, some little care should be observed to avoid producing sharp angles at the corners, and yet to secure a close adaptation and particularly at the bifurcation of the roots.

In extreme cases of ill adaptation or of exceedingly constricted necks, a good result may often be obtained by encircling the crown with a piece of German silver, or copper wire, from 24 to 20 gauge, passed through the interproximal spaces, and the ends then twisted from the

buccal side, until the loop breaks. This affords a uniform compression of the edge of the band by condensing the molecules, but in effecting it, it should be observed that the wire does not slip beneath the edge of the band, which tendency may be overcome by slightly *flattening* that portion which rests against the *lingual* surface of the crown, or which forms the center of the loop. While ordinary silver suture wire, or that made from other alloys or metals may be used, those recommended give the best results because of their tensile strength.

Wherever possible, all of these procedures should be observed, or executed, after the crown has been properly mounted, and a firm closure of the jaw should be maintained in order to prevent lifting it from its proper relation. The cement should first be allowed to become partially crystallized, also, in order that any slight hemorrhage produced may interfere as little as possible with its perfect crystallization.

Two or More Crowns. When two or more crowns are to be inserted at the same sitting, *each should be mounted separately,* as the crystallization of the cement seldom affords opportunity for the thorough and accurate mounting of more than one with each mixing; and the operator should never be hurried, nor make any effort to expedite matters to too great an extent in this procedure.

Therapeutics. In cases of extreme pain after mounting, which is sometimes induced by the irritating influence of the cement upon inflamed or hypersensitive tissues, but which is usually only temporary, relief may be afforded by painting the gums around the neck of the crown with a two or a four per cent. solution of cocaine; or with the tincture of iodine, or the usual remedies for counter-irritation. A spray of hot water is also sometimes very effective, and where an astringent may be indicated, in cases of congestion, zinc sulphate or a saturated solution of tannic acid in glycerine may be employed.

Use of Gutta Percha.

The difficulty encountered in the removal of crowns mounted with cement, and particularly of dowel crowns, has created a demand for some medium which would afford a secure and reliable attachment, and which would at the same time admit of subsequent removal in the event of necessity, without requiring the destruction of the crown or of any appreciable amount of tooth structure.

Advantages. The ordinary *red or pink base-plate gutta percha,* skilfully manipulated, seems to meet such requirements in admitting of easy removal, as well as to possess the additional desirable qualities of offering sufficient integrity in the attachment, and of being insoluble, non-irritating, and more or less impervious.

Its use also affords a somewhat cushion-like seat for the crown, which is an advantage because of relieving the "deadened blow" in the stress of mastication, and of thus reducing the shock, and diminishing the tendency of porcelain to fracture, as compared with a more non-yielding medium.

Disadvantages. The disadvantages incident to the employment of this material lie mainly in the skill and time required to successfully manipulate so refractory or intractable a substance; and yet its integrity as a substantial mounting is due to such properties, and will, of course, increase in proportion thereto, so long as it is capable of being rendered sufficiently plastic to be properly moulded, in the adjustment of the crown.

While its employment is probably more especially indicated for dowel crowns, this same essential property may here prove a disadvantage, if any great surplus is present, by offering sufficient resistance to expand the band, and thus destroy the accuracy of its adaptation.

This objection may be overcome, however, by careful manipulation in obtaining the maximum of plasticity, and avoiding the presence of any unnecessary surplus. Successful results will depend upon a willingness to consume time, and to observe the detail with deliberate painstaking care, as well as in the acquirement of the necessary degree of skill; and will increase in proportion thereto.

Procedure. In its manipulation, the material should be cut into narrow shreds or strips, from one-half to one inch in length, and these should then be slowly and carefully heated until plastic. The heating should be done at the chair, and may be best accomplished by placing them on a porcelain-lined electric gold annealer, such as is manufactured by Mr. M. M. Kerr, of Detroit, Mich.; or upon a mica slab placed over a flame, where they should remain until the mounting is completed. The Custer electric gold annealer has an accompanying porcelain slab which may also be used for this purpose.

Direct contact with the flame should always be avoided, as this destroys the working properties of the material by rendering it harsh and tough.

Dowel Crowns. While the gutta percha is being thus heated, the dowel of the crown should be spurred with a sharp knife-blade, and it and the interior of the cap then slightly moistened with a solvent of gutta percha to facilitate a secure attachment. Oil of cajeput is probably the best solvent for this purpose, though oil of eucalyptol or chloroform may be used.

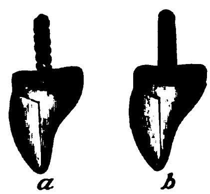


Fig. 223.

When thus prepared, a piece of the gutta percha should be picked up with foil carriers, coiled around the dowel from its apex downward, Fig. 223 A, and then packed down closely with the fingers. If one piece does not appear to be sufficient for the first trial, another may be added, until what seems to be adequate is obtained, but a surplus should be avoided.

The crown should now be placed upon the heater, and the canal and end of the root then moistened with a spray of water from a syringe, in order to prevent the gutta percha from adhering, after which the heated crown may be grasped with a napkin and forced to position. If no great surplus has been used, it will go readily to place without driving, when it should be at once removed, and small pieces of the heated material added, where needed; it is then placed again upon the heater, the root moistened, and this procedure continued until the gutta percha is moulded to fill the space between crown and root, when the correct relation exists.

All surplus should now be trimmed off even with the edge of the band, and the crown then replaced upon the heater.

In the event of the presence of too much gutta percha to admit of the proper adjustment, the surplus should be trimmed away with a hot instrument, and the crown reheated and carried to place, until the proper relation maintains.

Shell or Telescope Crowns. The procedure indicated in the mounting of the "shell or telescope" crown is the same, except that the gutta percha may be cut into small square pieces, of convenient size; and these should be placed in the bottom of the crown and around the joint between cusp and band, until they may be gradually moulded to fill the space.

Final Mounting. Up to this point, the root should be moistened previous to each application or trial of either style of crown, in order that its removal may be made easy by preventing adhesion.

When ready for the final mounting, the crown should be again placed upon the heater, and allowed to remain until the root has been rendered aseptic, and then thoroughly dried in the manner indicated in connection with cement. It should now be moistened with the oil of cajeput, or with a thin solution of chloropercha, and the crown then picked up with a napkin, and forced to place, where it should be held firmly for a few moments, until the gutta percha loses its heat, which may be hastened by a spray of cold water.

Combining Cement and Gutta Percha.

While either cement or gutta percha may be used in mounting shell or telescope crowns, on the posterior teeth, the advantages of both may be obtained for dowel crowns by combining them. This may be done in such manner as to admit of the subsequent removal of the dowel, in case of accident or necessity without any great difficulty, and to overcome any possible danger of enlarging the narrow band, such as may possibly result from the use of gutta percha alone.

Whatever advantages cement may possess as a mounting medium, it is seldom the best practice to *surround the dowel* exclusively with this material because of the extreme difficulty of ever removing it from the root. Hence, if one is not sufficiently skilled in the manipulation of gutta

percha alone, some means of facilitating the removal of such crowns, without injury to the root, is always indicated.

Procedure. This may be accomplished by using sufficient gutta percha, in the manner described, to surround the dowel only (Fig. 223 B) and then completing the mounting by filling the cap and coating the walls of the canal with cement, thus obtaining, in a measure, the advantages of both, with the minimum of the objections of each.

Various combination cements in which gutta percha filings, or gutta percha in solution, is incorporated with the oxy-phosphate of zinc, are advocated, but as their use is at present somewhat experimental they are not recommended.

Variations of Procedure.

The skill required to successfully manipulate gutta percha has caused the adoption of several variations of procedure, each with a view of accomplishing the desired result with greater facility and expediency.

Use of Chloropercha. A thick solution of gutta percha in chloroform is sometimes employed for the entire mounting of dowel crowns, but is not recommended, because of the shrinkage of such medium, due to the evaporation of the chloroform. This shrinkage will, of course, afford some opportunity for the subsequent loosening of the crown, and thus diminishes the stability and permanency of the attachment.

It may be used around the dowel and on the inner surface of the cap, however, in place of the base-plate gutta percha, and when so employed, the chloroform should first be evaporated by passing over a flame, and the crown then mounted with cement, as indicated. This prevents the adhesion of the cement to the surfaces of the dowel and cap, which, of course, facilitates the removal of the crown, but not to the extent afforded by the use of the gutta percha alone, when it entirely fills the canal.

Shellac and Sandarac Varnish. A heavy coating of shellac or sandarac varnish of a thick consistency will also prevent the adhesion of cement to the dowel, and likewise facilitate the removal of the crown.

Dodez' Rosin Compound.

An antiseptic rosin compound has been introduced under the name of *Onilite*, and is advocated by Dr. E. W. Dodez, of Fort Wayne, Ind. This preparation is highly antiseptic; melts at a point just high enough not to be affected by the temperatures of the mouth; is very adhesive, cools quickly, is easily manipulated and seems very useful, particularly for telescope crowns.

Rubber Tissue.

A preparation of rubber in the form of very thin tissue, which is quite adhesive, is recommended for similar use by Dr. W. F. Lawrenz, of St. Louis, but at the present stage of its experimental application, it seems to offer no particular advantages over the preceding materials, and is more difficult to manipulate.

Final Precautions.

When the mounting has been completed with apparent satisfaction, the patient should never be dismissed until it has been carefully ascertained that the crown is firm, and that the occlusion and all surrounding conditions are favorable; and a further precaution against any possible subsequent displacement, annoyance or discomfiture should be observed by requiring the patient to return in the course of a few days for final inspection.

Removing Crowns Mounted with Gutta Percha.

The removal of crowns mounted with gutta percha may be easily effected by applying sufficient heat to the exposed portion of the crown to soften the material. This may be done by heating the beaks of a pair of heavy pliers of good size, placing them on the crown, and sustaining the contact until the heat is conveyed throughout its length, which will usually be noted by a response from the patient, when the gutta percha surrounding it will be sufficiently softened to lose some of its adhesive properties, and admit of the ready detachment of the crown with a hooked or pointed instrument.

In this procedure, care should be exercised to guard the face and lips of the patient, as well as to protect the porcelain, which may be aided by cotton rolls or pads; and the pliers should be heated in the laboratory,

or where the heating may not be observed by the patient, and then carried to the chair wrapped in a napkin or towel, with only the beaks exposed, as a matter of convenience to the operator, and of protection and relief from fear to the patient.

A more convenient method which may sometimes be employed with success has been suggested by Dr. C. B. Rohland. This consists in placing a leather or moose-hide polishing wheel in the engine and revolving it with rapidity against the crown until the friction will thus produce sufficient heat to admit of its removal.

Accuracy in Model Making.

CHAPTER XVI.

Whilst much emphasis has already been placed upon the necessity for accuracy in impression taking and model making, these features of the procedure are of such paramount importance as to make special emphasis warrantable.

Throughout the entire procedure incident to the construction, or even the repair, of any style of crown, and particularly of those for the anterior teeth, a good impression and an accurate model are prerequisites to success, because by this means the work may be transferred from the mouth to the laboratory with all the exactness which successful achievement demands.

In order that the very best results may be obtained with the greatest degree of accuracy and expediency, the impression should always be taken in plaster because of its being the most reliable material; and the model obtained from it must support and sustain the cap—or caps—in the proper and exact relation which, when in the mouth, they bear to the roots, to the adjacent teeth, and to the gingival outline of the tissues.

The facility with which the cap, or caps, may be detached or removed from the model—and in such manner as to admit of ready and accurate readjustment—depends largely upon the observation of the detail of filling the interior of the cap, and covering the dowel, with a thin film of melted wax just previous to filling the impression, as is illustrated in Fig. 224 A for a lateral and in Fig. 224 B for a bicuspid crown.

This simple precaution readily admits of the easy detachment of the cap from the model, and of its accurate subsequent replacement, both of

which remove any difficulties or obstacles incident to the construction and assemblage of the parts, and to the subsequent removal and investment of the piece; and the preservation of the model thus made possible, affords opportunity for final trials at any time during or after the completion of the case, all of which are advantageous features.

a

Fig. 224. *b*

When the model has been separated from the impression, the cap may then be easily removed by slightly warming the surplus end of the dowel over a flame, and grasping it firmly with flat beak pliers, when a straight pull will quickly detach it, and yet leave an outline of such accuracy as to admit of its easy and correct readjustment to position. Fig. 225 A.

a

b

Fig. 225.

After thus removing the cap the wax should be burned out, and it should then be thoroughly cleaned in the acid bath to insure the further removal of all residue from, and perfect cleanliness of, the metal, when it may be placed upon the model, or laid aside for the time being, if prefer-

able, and the wax "bite" adjusted to position, Fig. 225 B, and the case then mounted upon the articulator.

When more than one crown is being constructed for the same mouth at the same time, one model and "bite" is all that is necessary, but each individual crown should always be *separately* invested and soldered.

Improved Articulators.

While the ordinary crown articulator previously illustrated in Fig. 71 may be used, and will, of course, serve the purpose, better results from the viewpoint of a more accurate articulation, which is decidedly advantageous particularly when porcelain is to be employed in any manner, may be obtained from the use of the more improved, and so-called *anatomical,* articulators, which are designed more especially for bridgework, and which admit of a slight forward, backward and lateral movement.

Two designs possessing these features which seem to be eminently practical are Kerr's Improved crown and bridge articulator, manufactured by Mr. M. M. Kerr, of Detroit, Mich., and the design manufactured by the Blue Island Specialty Co., of Blue Island, Ill., each of which are simple and inexpensive.

Principles and Technique of Bridgework.

History, Development and Ethics of Dental Bridgework.

CHAPTER XVII.

The art of dental prosthesis, and particularly in so far as it pertains to supplying missing teeth by attaching artificial substitutes to remaining natural ones—which is now termed *dental bridgework*—was doubtless, and is recorded as being, among the earliest achievements of primitive dentistry.

History.

As an art its origin has been traced to the remote epochs of the Egyptians, Phoenicians, Greeks, Etruscans and Romans, and archeological researches have unearthed specimens which give silent evidence, and prove beyond peradventure, that the possibilities of this art were recognized by the people of these ancient periods; that it was practiced by them to a greater or less extent, and that it antedated all forms of plates and other means of supplying missing teeth.

The specimens, especially of the Etruscans—"those wonderful fashioners of gold"—which are now to be found in archeological museums, bear so striking a resemblance to the efforts, even of the present time, as to cause us to marvel at their skill and ingenuity. Several comparatively excellent pieces of work, wherein missing teeth were substituted by human teeth, or by those of lower animals, and attached to remaining natural ones by means of gold wires and bands, clearly indicate that the Etruscan dentists were not only skilful in the manipulation of gold, but also that they were familiar with a variety of the requirements of dental bridgework. (Fig. 226.)

This is also seen in the efforts of the Romans who, it is recorded, constructed both *fixed* and *removable* appliances. While perhaps not attaining to quite so high a degree of artistic excellence, they nevertheless show their familiarity with the possibilities and requirements, and exhibit a surprising degree of mechanical ingenuity.

Fig. 226.

Whether or not such efforts became a lost art during the middle ages is of course not known, but as with all sciences and arts it is presumed to have at least suffered a period of marked decline.

Fig. 227.

In any event the beginning of a revival of these ancient methods was not marked until the early part of the last century, and, as with dentistry in general, and dental prosthetics in particular, the primary evidences of the advent of its evolution doubtless came from the French.

While a few crude reports of isolated cases preceded it, the first presentation of methods for thus supplying missing teeth was probably

made by F. Maury in a work entitled "A Treatise on Dental Art," published in the French in 1828, and translated by J. B. Savier in 1843. Among several illustrations of methods of supplying artificial teeth which are to be found in this early work, are at least *two* wherein remaining teeth, or roots, afford the sole means of attachment for the substitutes, without any apparent effort to secure stability by resting or impinging to any extent upon the adjacent soft tissues. (Fig. 227.)

Fig. 228.

The substitutes used at that time were largely those which had been carved from the "sea-horse" tooth, though the use of the crowns of human teeth so modified as to meet the requirements, is mentioned, and in some places occur descriptions of porcelain—or, as they were then called, *incorruptible*—teeth.

Development.

That which has been termed the "progenitor of modern bridgework" is recognized as having been first suggested by Dr. W. A. Dwinelle in 1856, when a description of a method of adapting a plate to the end of the root and

Fig. 229.

attaching an artificial tooth to it, was further supplemented by the statement that "the plate may be carried across an intervening space unoccupied by roots and an unbroken row of teeth mounted upon it."

However original this idea may or may not have been, it nevertheless sounded the tocsin for a revival of the methods of greater or less antiquity

and marked the beginning of an era of development which has resulted in the methods of today, and which development also must redound to the credit of American dentistry.

In 1871 Dr. B. J. Bing contributed largely to this development by devising an artificial tooth made of porcelain, and having a platinum bar projecting from each lateral side, the ends of which were to be anchored in fillings in the adjacent natural teeth. (Fig. 228.) This became known as the "Bing bridge," and, while applicable only to the replacement of a single tooth, its introduction nevertheless marked the advent of the modern application of *fixed* bridgework, for which its designer must be accorded the credit.

Shortly after this, in 1873, that great American genius, Dr. W. G. A. Bonwill, devised and presented a type of removable bridge wherein a metal tube, previously threaded on its inner surface, was mounted in the root canal, and used as a means of affording attachment for a removable crown. The crown was adapted to the root and sustained in position by a threaded dowel which passed through a perforation in its base and engaged with the tube, and was capable of carrying one adjacent tooth when provided with a means of preventing rotation. (Fig. 229.)

Fig. 230.

Those devices of mechanical and artistic ingenuity, however, which may now be classified as modern dental bridgework, had their beginning with the advent of the gold shell or telescope, and the band and dowel crowns; and hence, the practical application of this class of work, on modern lines, dates back only to the period between 1878 and 1883, when the usefulness of these styles of crowns first became recognized.

Since this time the development of methods involving various principles has been so rapid as to preclude further enumeration of any except those the application of which is regarded as being practicable at the present time.

Ethics.

Before entering upon a description of any of the various methods of procedure now employed, however, there are certain fundamental considerations of sufficient importance to demand special emphasis; not the least among which is that of ethics.

The many objectionable features incident to the wearing of "plates" and other forms of artificial dentures which derive their stability from impingment upon the soft tissues of the mouth, has caused the profession to be so deluged with a multitude of devices for overcoming such objections as, almost of necessity, to result in many of them proving absolute failures when subjected to the test of practicability. Hence the application of dental bridgework, even of the more modern forms of construction, like almost every other human effort, has been subject to both use and abuse, and has been productive of both good and evil.

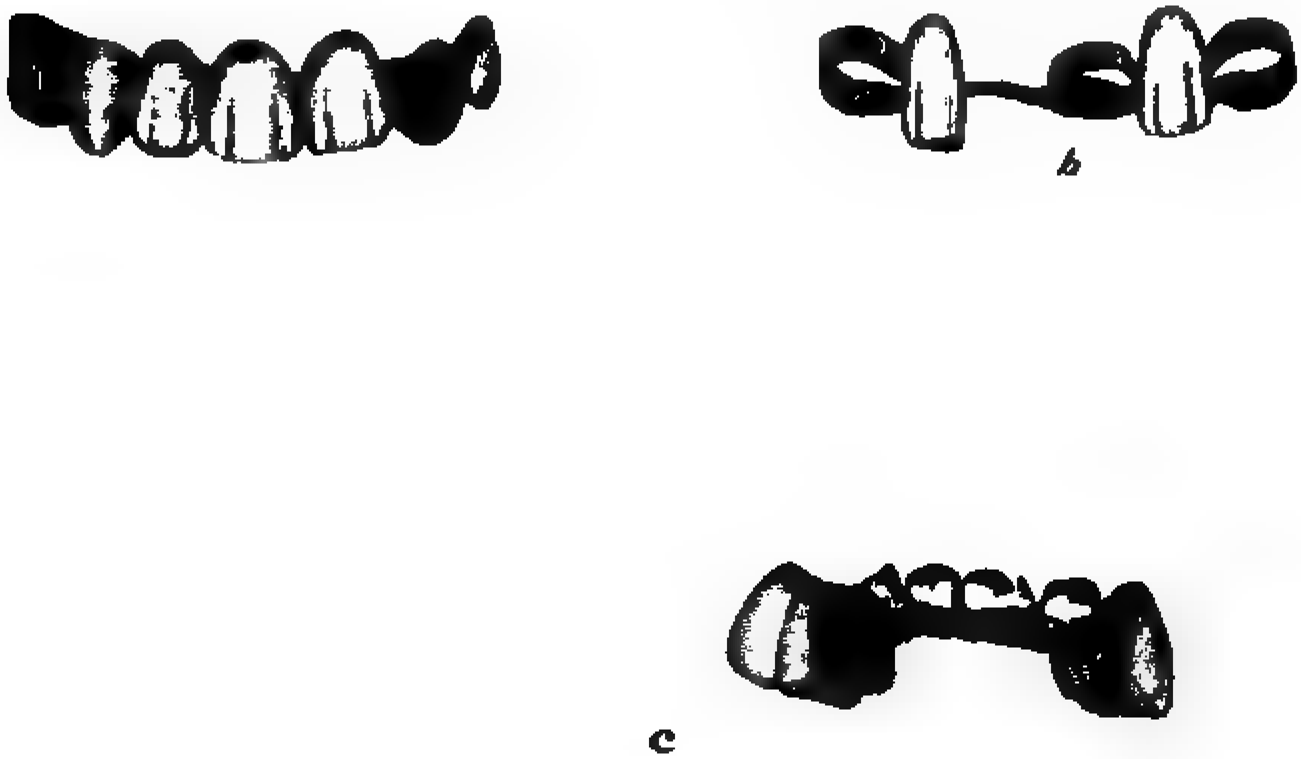


Fig. 231.

As any art must undergo its experimental stages, however, overenthusiastic and perhaps even indiscriminate application could not be well avoided, and such failures as must result therefrom should by no means provoke irrevocable condemnation. On the contrary, since it is by our failures that we learn and profit most, many of them were only a logical sequence, and have been but steppingstones to the gradual process of development.

That a large proportion of the early efforts in this direction were not highly successful must be conceded, but many of them were failures not so much because the underlying principles were wrong, but largely because of failure to properly observe them. Yet a proper observation of such principles could not well obtain until they became definitely known, and they could not become known except through experience.

A typical case of absolute ignorance of, or indifference to, the underlying principles and mechanical requirements, is shown in Fig. 230, where a cap without a dowel and two partial crowns were expected to support, and thus do the work of eight or nine teeth. The application of such devices could only invite and result in failure of the most pronounced type, but fortunately would usually do but little injury to the abutment teeth because of possessing so limited a degree of permanency.

Evil Effects.

It is true, however, that much *unnecessary* evil has occurred, but the greatest proportion of such results can undoubtedly be traced directly to the degree of over-enthusiasm, and pecuniary greed, which has induced an injudicious and indiscriminate application at the hands of uneducated, unskilful and unscrupulous operators.

Such lamentable efforts as these usually come from the hands of those who conduct the so-called "dental parlors" and make "teeth without plates;" where many teeth are crowned which should and would otherwise be filled; where the application of a glaring gold crown on any tooth, or bridges like those illustrated in Fig. 231, is but the work of a few moments; and where the salvation of a tooth, the development of an art, and the honor of a useful profession is sacrificed on the altar of Mammon.

In the "bridges" illustrated the one designated "A" shows where five teeth are attached to two gold crowns adjusted to teeth which have received no preparation whatever; "B" shows the two laterals suspended by three simple bands, also similarly adjusted, and "C" shows a most flagrantly impracticable specimen of so-called "alveolan dentistry." While the former case was doubtless capable of affording some degree of permanency, yet it would indeed be difficult to conceive of anything more inartistic; and the latter cases (B and C), while almost equally inartistic, could only result in the early disintegration or loss of the teeth thus banded.

Indeed, above all others, the one practice which has done more to retard the development of this art along practical and mechanical lines, and which has been productive of a most baneful influence upon supporting teeth, has been that of the indiscriminate and pernicious use of *simple bands* for supporting missing teeth.

This utter disregard for the laws of mechanics and hygiene, and for the requirements of art and esthetics which successful application of this art demands, has undoubtedly resulted in a class of work which could only prove to be a positive source of injury to the teeth and health of the victim, and which could also but invite the premature loss of a multitude of good sound teeth, and much attending discomfiture, and discouragement.

Notwithstanding these flagrant evidences of *commercial* dentistry, the development of this art in the past decade has placed it upon a sound scientific and practical basis; and if its application be so governed, and conscientiously made, there should be no reasonable excuse for the loss of teeth, or for failures.

Good Effects. The real benefit which has been derived by both the profession and the laity from a judicious and skilful application is beyond comprehension or contradiction. As pertains to the profession, the advent of bridgework has been the means of affording a training in artistic and mechanical technique unequaled by any other phase of dentistry, and the possibilities, which were early recognized, have served as a constant stimulus to the inventive genius of its members.

It has served to make the operator a better mechanic, and consequently in turn a better operator, and also to increase his artistic attainments and thus make him a better dentist. Unlike the advent of vulcanite work, it has brought the two departments of practical dentistry into closer relationship, and has elevated the art of dental prosthesis beyond the sphere of mere laboratory mechanics.

In so far as benefits to the laity is concerned there can be no doubt but that a well-planned, skillfully executed and properly adjusted bridge, when indicated, will contribute much to the comfort and health of the patient who is thus disfigured by the premature loss of natural teeth.

To obtain these desirable results in a large proportion of cases has been made possible by the development of this art, but their achievement demands a broad and liberal knowledge of the requirements; underlying principles and limitations, and a thorough and conscientious execution of the details.

In this connection it must be remembered that the conditions with which we meet vary to a greater or less extent with each individual case, and that no mechanical device which is designed to become a part of the human economy is capable of universal application.

Hence it is the duty of the conscientious operator to study each case presenting with a view to accomplishing, not in the most simple or ex-

peditious manner, but in the best and most favorable manner those results which in his judgment will seem to offer the very highest possibilities from the combined viewpoints of simulating nature and restoring lost function.

If he be not qualified to do this, or is unwilling to do it conscientiously, he has no right to inflict unskilful or indifferent services upon a confiding patron.*

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*An acknowledgment of indebtedness for some of the references made and illustrations used in this chapter, is hereby made to Dr. Vincenzo Guerini, of Naples, Italy (*Dental Cosmos*, January, 1901); Dr. M. L. Rhein (*Dental Cosmos*, February, 1894), and to the "American System of Prosthetic Dentistry," and Evans' "Crown and Bridgework."

Classification, Principles and Requirements of Dental Bridgework.

CHAPTER XVIII.

Classification: Abutments; Attachments or Abutment Pieces; Dummies. Removable Bridgework. Fixed Bridgework: Extension Bridges, Saddle Bridges, Interrupted Bridges. Advantages and Disadvantages of Bridgework. Principles: Application to Fixed Bridgework. Application to Removable Bridgework. Requirements: Physiological; Abutments, Devitalization of Pulp, Hygienic Considerations: Physio-Chemical Aspect, Mechanical Preparation of Abutments, Adaptation of Attachments, Construction; Contact, Articulation and Occlusion, Assemblage. Esthetic.

The practice of no phase of the science or art of dentistry requires the exercise of so great a degree of *mechanical ingenuity, manipulative ability, artistic attainment, and good sound judgment* as is demanded in the successful application of dental bridgework. Whenever the application may be made along these lines, however, or in consonance therewith, there is also no phase of dental art which offers greater possibilities, or greater opportunities for successful achievements. Furthermore, the success which may be thus attained contributes as much to the appearance, comfort and health of the patient as it does to the satisfaction of even the most conscientious and ambitious practitioner.

Classification.

Technically, dental bridgework constitutes an assemblage of *attachments* or *abutment pieces,* and intervening or adjacent *dummies,* which, when united, afford a continuous incisal or masticating surface.

The principles underlying the mechanical means of supporting the work are derived mainly through attachment to the natural teeth, and while the intervening teeth are usually placed in direct contact with the contiguous soft tissues, any support which is afforded by, or obtained

from, such impingement is necessarily supplementary, and consequently becomes a secondary consideration.

Abutments.

The anchorage may be secured either upon the roots, or to, or in the crowns of the natural teeth, and the teeth thus used are known as "abutments."

Attachments or "Abutment Pieces."

The methods of anchorage to the natural teeth which are employed may be, and are, designated as *attachments* or "abutment pieces."

Dummies.

The artificial substitutes for the missing natural teeth, which are supplied by, and which form the body of the bridge are commonly known as "dummies."

When the attachments or "abutment pieces" and "dummies" are assembled they constitute a mechanical device, which, "like a continuous chain, can be no stronger than its weakest link," and which in its attachment can possess no greater degree of strength than is afforded by the stability of the supporting teeth. Hence, the practicability of the piece will depend, *first*, upon the stability of the abutments, and, *second*, upon the manner in which it is planned and constructed.

Irrespective of the many variations of construction, the application involves but *two* general lines of procedure. These may be classified as *removable*, and *fixed* or "stationary" bridgework.

Removable Bridgework.

Removable bridgework embraces that style of construction wherein an impingement of the body of the piece upon the contiguous soft tissues is supplemented by some form of attachment to the abutment which affords temporary fixation and stability when in position, and yet admits of the ready removal and replacement without disturbing the integrity of any of the parts.

Fixed Bridgework.

That type of construction which is designed to be securely and permanently anchored to the abutments in such manner as to preclude its removal without the mutilation of the attachments, thus becoming a fixed or integral part of the denture, is designated as "fixed" bridgework.

Extension Bridges.

That style of construction wherein the possible stability of the abutments admits of extending one or two teeth either posterior or anterior to an attachment, without any additional support except that afforded by impingement upon the soft tissues, is designated as "extension" bridges. While usually applied with special reference to "fixed" appliances the principle is nevertheless, of course, likewise applicable to "removable" ones.

Saddle Bridges. The term "saddle bridges" is applied to that type of construction wherein the body of the bridge is conformed to the outline of, and placed in contact with, the gum tissue. The designation mainly applies and refers to "fixed" bridgework, for the reason that *all* removable appliances are so constructed.

Interrupted Bridges. The term "interrupted" bridge is applied to that type of construction in which the presence of a remaining natural tooth *not required as an abutment* may cause an interruption in the continuous relation of the parts. The relation of the various parts to each other and the integrity of the bridge, however, is sustained by the use of a heavy bar of platinum, iridio-platinum, or gold, adjusted to conform, approximately, with the outline of the lingual surface of the remaining tooth, without resting upon it, impinging upon the soft tissue, or interfering with the occlusion. This principle is also applicable mainly to "fixed" bridges, though technically it may, of course, be likewise applied to those which are removable.

Advantages and Disadvantages of Bridgework.

The application of dental bridgework, of either of the two general types of construction which have been designated as "fixed" or "removable" in character, presents phases of advantages and disadvantages which, while being mainly applicable to the *former* class, are nevertheless also more or less applicable to the latter class, though always in a more modified form.

Advantages. The advantages generally claimed may be enumerated as follows:

1. The removal of the many deficiencies associated with the substitution of missing natural teeth by means of the more common forms of plates which depend entirely upon contact for retention.

2. The overcoming of the more or less embarrassing features coincident with the wearing of artificial teeth supplied by such means of retention.

3. The avoidance of any mechanical abrasion of the remaining natural teeth from *clasps*, or *contact of plate*, and the preservation of their integrity, and of the normal condition of the contiguous tissues, thus overcoming any possible tendency to looseness and subsequent loss which may result from such contact.

4. The removal of the impediment to speech, taste, etc., which is usually caused by plates.

5. The more perfect reproduction of masticating surfaces which is afforded by the firmness and immobility derived from a more *fixed* type of construction.

Disadvantages. The disadvantages incident to the substitution of lost teeth by means of bridgework are summarized as follows:

1. The possible necessity for the devitalization of the pulp, and the mutilation of perhaps sound teeth, which must necessarily be employed as abutments.

2. The unnatural condition established by the secure fixation of the roots of two or more teeth.

3. The additional stress to which the abutments are necessarily subjected.

4. The progressive degeneration of the peridental membrane which may thus possibly ensue, cause looseness, and result in subsequent loss of teeth.

5. The unhygienic and consequently unhealthy condition which may be induced by the wearing, particularly, of extensive "fixed" bridges.

An analysis of the possible advantages and disadvantages as thus enumerated would seem to leave some degree of doubt as to the general practicability or impracticability of this class of work. Clinical experience has proven, however, that if the application be judiciously made, and made in accordance with a knowledge and observation of the underlying fundamental principles, and the physiological and mechanical requirements, the possible unfavorable conditions may be minimized, and the opportunities for obtaining the more favorable ones be correspondingly enhanced.

As these considerations apply to bridgework in general, the particular advantages and disadvantages incident to the judicious application of *each respective type of construction,* and the indications and contra-indications for same, will first be generally considered under the caption of *principles,* and then subsequently further discussed in connection with the presentation of methods of construction.

Principles.

In a previous consideration of this subject, it has been correctly stated that the application of dental bridgework involves "a multitude of devices which depend upon a few limited mechanical principles"; and yet, however few may be involved, a knowledge of the fundamental principles underlying the application of any mechanical pursuit is always to be considered as a prerequisite to successful achievement, and particularly so

when these principles are to be applied to structures attached to the human body.

In the procedure incident to devising and constructing dental bridges, the first and most important considerations presenting are obviously those of the *stability* of the teeth, which are to serve as *abutments,* and the *requirements of occlusion,* which, as viewed from a mechanical aspect, are co-incident with the physical considerations of stress and resistance.

Irrespective of the innumerable variety of methods of attachment which are employed, the general principles underlying the application of this work apply, fundamentally at least, to any style of construction, though always with somewhat less force to those which are designed to be "removable" in character than to that style which is intended to become a "fixed" part of the denture.

In either class of construction, in proportion as the stress imposed upon, or to be assumed by the abutments is diminished, the number of "dummies" which they may be reasonably expected to support of course increases; and, irrespective of the method of anchorage, the degree of stress to which the abutments must be subjected will depend largely upon the number of remaining natural teeth not included in the bridge, and will decrease in proportion to the degree to which the normal occlusal relations may be restored.

Thus the presence or absence of occluding natural teeth will so affect or relieve the abutments as to govern the indications, to a large extent, for each respective type of construction, and to bear materially upon the practicability or impracticability of either.

Hence these physical and mechanical considerations demand that the construction of dental bridges be based largely, if not exclusively, upon the conditions and the requirements of each case; and those are usually so diversified in range as to preclude the universal application of any one general line of procedure.

Application to "Fixed" Bridgework.

As related particularly to the application and construction of "fixed" bridges, the root of almost any tooth in the arch is so cushioned and protected by nature as to render it capable of withstanding *vertical* stress to a degree exceeding its own individual requirements; hence it may be generally accepted as a cardinal principle that *one tooth is capable of performing the function of two*—under favorable conditions. Since a similar protection against *lateral* stress, however, *is not afforded* by the nature of the surrounding tissues, all roots, and particularly those of conical shape, will yield more or less readily whenever in any manner subjected thereto. For

this reason the provision, *under favorable conditions,* means much as regards the application of the principle, and the practicability of the work constructed in accordance with it. It means, first of all, that the physiological condition of the tooth, and of its surrounding tissues, must be favorable; and, second, that the *mechanical demands* imposed upon it must be within the limits of its endurance.

An observation of the combined *physical* and *mechanical* requirements thus imposed would demand, first, that the tooth to be so utilized must possess a degree of inherent stability *equal to or greater* than that required of the substitute which it is to support; and second, that a means of fortifying it against leverage or rotation on its long axis, or against the possibility of *any lateral* movement, must be provided.

Thus, from a physical viewpoint, it is apparent that it would not be practicable to expect a lateral incisor to support a central incisor, or a cuspid; nor a second bicuspid to support a first molar, because the natural requirements occasioned by the proportions of the root, or the location in the arch, of the tooth so supported *exceed* those of the abutment or supporting tooth.

Reversing these conditions, however, it would be reasonable to expect a central incisor, or a cuspid, to support a lateral incisor; a first bicuspid to support a cuspid; a second bicuspid to support a first bicuspid, or a first bicuspid to support a second bicuspid, and a first molar to support a second bicuspid, because in these instances the inherent physical stability and natural requirements of the abutment or supporting tooth *exceed* or *equal* those of the tooth which is thus supported. Likewise, a central incisor will support the adjacent central, because in this particular instance the abutment or supporting tooth possesses a degree of stability *equal* to the requirements of the supported tooth.

This general principle, however, applies only to one end of even the most simple bridges, and, as a rule, its practicability will demand that the other end be adequately protected against the leverage produced by lateral or even vertical stress, as previously mentioned. An exception to this latter requirement, however, as applied to the first molar, may sometimes be made, as this particular tooth, owing to its relative proportions and position in the arch, will usually support a second bicuspid without such a provision.

As pertains to a more extensive application of general principles to typical cases, the following may be generally accepted as being practicable, if it be generally understood and appreciated, first, that by uniting two teeth they act as one, capable of withstanding a minimum stress of two; second, that there can be no movement of the piece independent of the

abutments themselves, and third, that the stability of the piece will depend upon the *strength* and *position* of the abutments, and the security of the attachment to them.

Fig. 232.

Type A.

The two central incisors will support the two lateral incisors, and often if the roots are of good proportion and in reasonably good condition, the two laterals will in turn support the two centrals. (Fig. 232, A and B.)

Type B.

The two cuspids will usually possess sufficient stability to support the four incisors. (Fig. 233.) This principle is always applicable to the lower arch,

Fig. 233.

but as applied to the upper arch the degree of practicability will depend largely upon the occlusion, and will increase in proportion as the length of the *overbite* may be shortened. (Fig. 234, A.)

Thus, if the occlusion may be made so as to have the incisal ends of the upper teeth come in *direct contact* with the incisal ends of the lower teeth—which is commonly designated as an "end to end" bite (Fig. 234, B)—or as nearly so as possible—the degree of *lateral* stress is di-

a *b*

Fig. 234.

minished, and the stress thus becoming more nearly *vertical*, which is in line with the greatest resistance, makes the application more favorable, and precludes the possibility of the cuspids being forced forward, or outward and upward, ultimately producing a separation between them and the first bicuspids.

Fig. 235.

This displacement will almost invariably result when considerable "overbite" exists, though the presence or absence of the posterior teeth, and the accuracy of their occlusion, will have a marked bearing upon this tendency to subsequent protrusion, because their presence would

naturally relieve the anterior teeth of much stress, which an interrupted occlusion produced by their absence would occasion.

Type C. Such a tendency or possibility, in this connection, would practically be entirely overcome by the presence and use of an intervening central or lateral, because of the increased resistance thus afforded. (Fig. 235.)

Fig. 236.

Type D. As a good tooth on each end will always support two intervening teeth in any application, the cuspid and first molar will, of course, support the two bicuspids (Fig. 236, A), or the two bicuspids and lateral. (Fig. 236, B.) Either one of these applications is typically practical, because of the maximum degree of stability obtained from the use of these particular teeth as abutments.

Fig. 237.

Type E.

The second bicuspid and second molar will support the first molar and first bicuspid without any additional anchorage anterior to the latter. (Fig. 237, A.) In this construction, however, it is not usually desirable or necessary to have the first bicuspid "dummy" possess an appreciable occlusal surface, *for the reason that this particular tooth is seldom required to do much masticatory work*, and the strength of the bridge will be increased by throwing the actual work upon the three teeth posterior to it, two of which are abutments.

a *b*

Fig. 238.

Type F.

As a general rule, the first bicuspid and first molar might be expected to support the second bicuspid and second molar, without any additional anchorage at the posterior end. (Fig. 237, B.) In this construction, however, while the presence and use of the third molar may not be necessary, because of the stability of the first molar, still its employment would, of course, add strength to the fixation of the work, and appreciably relieve both of the other abutments. As the third molar and first molar, however, would also support the missing second molar and second bicuspid, it would always be best to use them, and thus avoid employing the first bicuspid at all.

Type G.

While the cuspid and second molar will usually support the three intervening teeth (Fig. 238, A), the same degree of success and permanency offered in this application is not usually to be obtained where the third molar is used as the posterior abutment, and four intervening teeth are supplied. (Fig. 238, B.)

In the event of the forward gravitation of this tooth, however, to an extent which will only require, or admit of, *three* intervening dummies, the use of the third molar is, of course, more practicable, and increases in proportion to its size and stability.

Type B.

The two cuspids and the first molar on one side will usually support the intervening four incisors and two bicuspids (Fig. 239, A), and while the three teeth will thus be required to do the work of nine, such a structure is nevertheless practicable, if the occlusion and stability of the abutments are favorable.

Fig. 239.

The two cuspids and two first molars will also usually support the entire denture anterior to the latter teeth (Fig. 239, B). Where other than the first molars can and must be used, however, the stability of the abutments is lessened, while the requirements are increased, and consequently the degree of practicability is not so great.

Throughout the construction of this work, by far the largest proportion of success will be derived from the use of *small bridges*, and the opportunities for achieving these desirable results will usually be *lessened* as the operation becomes more *extensive*, or as the number of teeth involved increases.

Supplementary principles which will materially add to the opportunities, and which must always be observed if success is to be attained, are herewith indicated:

1. Do not attempt extensive operations with a view of obtaining more or less permanent results in the mouths of patients under fourteen or fifteen years of age, as the conditions are usually very unfavorable at this time.

2. Do not use loosened and unhealthy roots for abutments, as such conditions only invite failure.

3. Always increase the resistance and lessen any possible chance of failure by utilizing a *maximum* instead of a *minimum* number of abutments.

4. Always make every possible mechanical provision against the influences of *lateral* or antero-posterior stress.

5. Always avoid an interlocking occlusion or an unfavorable *articulation*, which will in any manner interfere with or prevent the free lateral movement of the mandible in the act of mastication.

6. Have the occlusion of the abutments, if anything, more *definite* than that of the "dummies," whenever possible, and provide the latter with as small an occlusal surface as is consistent with the requirements of mastication, thus minimizing the stress to be endured by them.

Application to "Removable" Bridgework.

While these same general principles apply also to "removable" devices, yet the advantages obtained from the support derived from impingement upon the soft tissues, together with the slight degree of mobility which the attachments for this class of work usually afford, imposes less actual stress upon the abutments. Hence, in proportion as the stress imposed upon, or the work required of the abutments is diminished, the number of teeth which they may be reasonably expected to support increases.

The successful application of dental bridgework is based so largely upon the existing physiological conditions as to preclude the adoption of any positive rules which will be absolutely universal in application, but the opportunities for success will increase as the practitioner who essays to do such operations becomes familiar with the fundamental laws of *dynamics*, the science which treats of the principles of force.

Requirements.

As the application of bridgework necessarily embraces a combination of surgical and mechanical procedures, a degree of familiarity with the preceding underlying principles must be further supplemented by a more or less exhaustive knowledge of the closely allied sciences of pathology and therapeutics.

With these attainments as a foundation, a higher appreciation of the actual *requirements* will follow, and while the limitations and apparent simplicity involved would seem to indicate that the application of dental

bridges does not usually or necessarily present serious phases, nor extreme difficulties, yet, nevertheless, the operator is often confronted with many interesting and *some* perplexing problems.

In proportion, however, as such fundamental knowledge in the composite may be acquired, the scope of opportunities for attaining successful achievements, and for the solution of difficult problems, will, of course, be enlarged.

A consideration of the actual *requirements* involved in the practical and successful use of this class of work may be best presented by classifying them as *physiological, mechanical and cosmetic,* the relative order in which they present, and treating them from the separate viewpoint of each respective class.

Physiological.

The special requirements which may be classified as presenting a physiological aspect include those, of course, which bear materially upon the restoration and preservation of the normal condition of the abutment teeth and contiguous tissues.

Abutments.

The placing of the roots of the abutment teeth in a proper, and in the most favorable condition is necessarily the first consideration, from a physiological viewpoint. In this connection, all that has been previously said concerning the physiological and therapeutic aspect of the requirements incident to the preparation of roots for *single crowns* is applicable with even *greater emphasis* to the treatment of those which are to serve as abutments for bridgework.

Devitalization of Pulp.

As applied particularly to the question of the practicability of devitalizing the pulps in those teeth *which are to be crowned,* and which are to further serve as supports for bridges, the previous recommendations should be even more forcibly observed, for the following reasons:

1. Because the application of bridgework of any form should always be made with a view of obtaining the highest possible degree of comfort and permanency.

2. This desirable degree of comfort and permanency will usually obtain and increase in proportion to the manner in which the supporting or abutment teeth may be placed in a condition offering immuunity from subsequent pathological disturbances.

3. The application of a piece of bridgework should offer no more

opportunity for the action of deleterious influences of any nature than existed before its insertion.

4. Such influences may be induced by the abnormal stimulation of the contents of the tubuli, or of the pulp—as a result of the shock incident to the preparation of the root; or from the increased or diminished thermal action, which irritation may result in a rapid or in a slow destructive process; or in the formation of "pulp nodules"; or ultimate death may ensue from stasis of the blood supply, or from peridental atrophy, as a result of the vise-like fixation of the tooth in its socket.

In any event, an abnormal condition is established, and even more mechanical preparation is required; hence, the most conservative judgment must be exercised, with a view of placing the roots in the most favorable condition possible.

If the tooth is to be entirely encompassed with a "shell or telescope" crown, this will usually demand that the pulp be removed, and that the canals be placed in an aseptic condition and their apices filled with a substance which will act as an impenetrable barrier to the subsequent invasion of pathogenic organisms.

The exceptions of age, as previously noted, however, will guide the operator in the practicability of such a procedure, but with these exceptions, and since the pulp is recognized as being purely a formative organ, the practice under these conditions should be more or less general.

Hygienic Considerations.

The success of this class of work, from the viewpoint of the comfort and health of the patient, will demand that every means for obtaining as hygienic a condition as possible must be observed.

To obtain this, the device must be well adapted to the supporting teeth, and all shoulders and pockets which would invite the accumulation of food products must be avoided. All parts in contact must also be well adapted to the contiguous soft tissues, and any sharp and irregular edges which might cause irritation and hypertrophy, should be removed. Lingual surfaces which will be sufficiently accessible to the bristles of a toothbrush to admit of being kept reasonably clean must be provided, and as large interproximal spaces as is consistent should exist.

Physio-Chemical Aspect.

As applied particularly to "fixed" bridgework, a physio-chemical aspect presents which makes it necessary that the *mounting medium* should be protected against the action of the secretions, and thus contribute to the hygienic conditions, as well as to the preservation of the supporting teeth, and to the permanency of the operation.

In this connection, also, it is desirable to use as high a karat of gold as permissible—when gold is used at all—throughout the construction of the work, and that all exposed surfaces should be *well finished* and *highly polished* before mounting, in order that the susceptibility to discoloration through chemical action of the secretions of the mouth may be diminished.

Indeed, every precaution against irritation, and against affording opportunity for the action of the products of fermentation, should invariably be observed.

Furthermore, when every effort to provide a device which will be as self-cleansing as possible has been made, it is then the duty of the operator to instruct the patient in the proper manner of keeping it scrupulously clean, and to advise him of the necessity for it. If all of these precau-

g. 240. *b*

tions are properly taken the most objectionable features of "fixed" bridge-work will be largely removed, and when they can not be, such methods of procedure are rarely indicated.

Mechanical.

The requirements which present from a purely *mechanical* aspect are so closely allied with those which have been considered as "physiological" as to be scarcely second in importance, and hence success will of necessity be co-dependent upon an observation of both of these phases of the underlying prerequisites.

Preparation of Abutments.

The first consideration in this particular connection is obviously that pertaining to the mechanical preparation of the abutments.

While the requirements involved demand the paralleling of the remaining walls of the natural teeth, as outlined for individual crowns in Chapter VI., the proper and ready adjustment of the bridge after the respective attachments are rigidly united *also demands* that the axial walls of the abutments must be reduced until presenting *parallel* lines, as illustrated in Fig. 240, A and B.

From these illustrations, presenting more or less common conditions,

it will be observed that a lack of *at least* absolute parallelism between the axes of the projecting ends of those teeth which are to support "telescope" crowns will preclude the subsequent adjustment of the bridge, *if the crowns even approach a close fit* at the neck.

Thus, in reducing the walls of the abutments, in the manner indicated in Chapter VI., this requirement must be observed, and if sufficient accuracy may not be gauged by the eye, exactness may be obtained from actual measurement by the use of a small pair of pointed calipers, by which means it may be definitely ascertained whether the *antero-posterior* dimensions between the *cervix* and *occlusal* ends are the same.

In instances where a "telescope" crown is used upon one abutment, in combination with a "dowel" crown upon another, and where the axis of the root supporting the latter is not parallel with that of the one supporting the former, as illustrated in Fig. 241, it will be necessary to reduce the *projecting* antero-posterior walls of the root supporting the "telescope" crown, until they may be made nearly parallel with the root canal which is to receive the dowel, in order that the assembled bridge may go readily to place.

Even then it will usually be necessary to enlarge the orifice of the canal somewhat to admit of *starting* the bridge toward its correct adjustmen; and when *two or more "dowel crowns" are used under similar conditions,* it will be necessary to observe this particular requirement, and then also to allow the dowels to extend into the canals only to a depth which will admit of the proper adjustment, and yet insure at least the minimum of necessary strength in the attachment between crowns and roots.

Adaptation of Attachments.

The adaptation of the attachments to the abutment roots must be sufficiently strong to insure permanency, and preclude subsequent mobility or displacement when subjected to stress, and must also be sufficiently accurate to offer no possible source of mechanical irritation to the soft tissues.

Construction.

The requirements of construction demand that the features of *contact* with the contiguous tissues, of *articulation and occlusion,* and of *assemblage,* must all be carefully observed.

Contact.

The relation between the various parts of the bridge and the soft tissues must always be of such a nature as to preclude any irritation which may result in subsequent hypertrophy and attending discomfiture.

This will require that *the necks of all facings,* and all surfaces and edges of the metal construction which are to be placed in contact with the tissues must be *nicely rounded* and *perfectly smooth,* and that any *undue*

a *Fig. 242.* *b*

pressure which would be likely to cause superficial or capillary stasis must be avoided.

Articulation and Occlusion.

No phase of the construction of bridgework is more important than the requirements of articulation and occlusion.

Bearing upon the requirements in this particular, it has been previously stated that by uniting two or more teeth "the movement of each is so modified and restrained as to enable them to successfully withstand more force than the sum-total of their separate resistances," but this theorem is usually applicable only to those teeth, the axes of which are in *parallel lines;* and one of the most common errors made in the construction more particularly of "fixed" bridgework is the increased stress which is thrown upon the abutments, without due regard for the resistance offered.

Hence, in the construction of this work the directions of the least and greatest resistance of each abutment must be noted, and the articulation and occlusion so adjusted as to conform as closely as possible thereto.

In this connection, it must be remembered that the abutments will withstand the required degree of *vertical* stress—if the application of the piece be judicious, but that any tendency toward antero-posterior or lateral movement lessens the permanency of the work.

For this reason the occlusion must be so adjusted as to control or at least minimize any movement in these directions; and, as the cusps increase in depth, the stress of articulation becomes more severe, and hence the tendency to displacement or failure is thereby increased.

If the axes of the abutment roots, however, are in parallel lines, as illustrated in Fig. 242, A, any antero-posterior movement either in the direction of greatest or least resistance is, of course, mutual, but if they are not parallel, as shown in Fig. 242, B, when one abutment is subjected to stress in the line of its *greatest* resistance, the other receives it at its *least.*

In properly dealing with these conditions, the occlusion of the abutments and intervening dummies in the *latter* class should be so adjusted as to *relieve* the stress of the occlusion on the dummies somewhat, and to throw the greatest stress in the line of the greatest resistance *on each individual abutment,* but each abutment must always receive the forces of mastication squarely upon its occlusal surface, *bucco-lingually,* in order to avoid lateral tendency.

This may be accomplished only by a *proper formation of the cusps in their relation to the opposing teeth,* and in order to reduce the stress upon the abutments *the cusps of the dummies should always be smaller bucco-lingually* than those of the crowns, and no larger than the absolute requirements of usefulness will demand.

The proper arrangement and adjustment of the articulation and occlusion of bridgework, in accordance with these requirements, and the usefulness of the work, together with a proper observation of precautions against displacement or accident, are of sufficient importance to demand special and painstaking attention, and the best results will doubtless be afforded by the use of an anatomical articulator, or one which will at least admit of some lateral movement.

Assemblage. When the construction of all of the crowns and dummies constituting the respective parts of the finished bridge has been completed in individual form, and since the piece can possess no greater strength than its weakest point, the assemblage should be made in such manner as to insure *adequate* and *uniform* strength and integrity.

Cosmetic.

The cosmetic requirements incident to the construction of this class of work demand that conspicuous or unnecessary display of gold should be avoided, and that the *individuality* of all teeth which are placed within the range of vision should not be destroyed by arranging them, or their

backings, in such close proximity as to leave no interproximal spaces, or no separation between their incisal ends.

The artificial teeth should be selected and arranged in accordance with the requirements of color, size, shape, alignment and characteristics, and if the highest artistic results are to be obtained, it is essentially desirable that the "dummies" within the range of vision should be of the *same length* as the abutment crowns, or adjacent natural teeth.

Whenever occasion indicates the observation of further artistic efforts, resort may be made to tinting with mineral paints or colored "bodies," or to the insertion of small gold fillings, as a means of making every possible effort to have the artificial substitutes in harmony with their environment.

"Fixed" Bridgework.

CHAPTER XIX.

Fundamental Requirements for Success; Good Judgment, Skill, Preliminary Considerations: Devising and Planning the Procedure, Construction of Attachments, "Bite" and Impression, Models, Precautions Incident to Investing, Mounting on Articulator, Construction of "Dummies."

In the construction of "fixed" bridgework, the great law of variation enters so prominently into each case, and the requirements of individual cases are in turn so diversified, as to practically preclude the adoption of specific rules. For this reason it is apparent that no special methods, nor modes of procedure, may be classed as universally applicable.

Hence, since this particular field of effort, as now practiced, is comparatively modern, we can not be guided altogether by the advantages which might be derived from an extensive experience, but on the contrary, must depend to a large extent upon close clinical observation combined with the intuitive or acquired genius of a practical mind and hand, so trained as to work in consonance, for the application of such principles and methods as will seem to be indicated, and to offer the most favorable opportunity for achieving successful results.

Fundamental Requirements for Success.

Thus it will be observed that the successful application of any form of dental bridge, and particularly of a "fixed" type, is, first, altogether a matter of judgment, a faculty which may only be acquired or developed by observation and study, while success or failure in so far as pertains to the construction will depend largely upon the display of *skill,* or lack of it, in the execution of detail.

Good Judgment. This faculty of good judgment may be best acquired by first obtaining a knowledge of the correct principles, and then closely observing the successes and failures as they present from time to time, and by studying the cause and effect of each respective result, a duty which every conscientious operator essaying to do this class of work owes to his profession, to his patient, and to himself.

Skill. The acquirement of skill, however, is a different matter, and while it is true that *personal equation* enters prominently into the development of ability to comprehend and successfully execute the detail of all pursuits, and particularly of those which combine both art and mechanics, and also that we may learn by absorption, yet, nevertheless, it must always be remembered that while genius may be the product of *heritage,* and *individuality* the product of environment, *skill* is but the product of a *gradual development.*

To summarize, then, the success of this class of work in any of the various phases of its application, will be co-extensive with, and indeed dependent upon, a conscientious observation of two fundamental principles, *i. e., judgment in application,* and *skill in execution,* and will, of course, increase in proportion as these façulties may be developed.

In questions of doubt the conservative rather than the radical procedure should always be given precedence, as the best interests of the patient, and the reputation of the operator are at stake, and both should invariably be conserved.

Preliminary Considerations.

As "fixed" bridgework is essentially an assemblage of "attachments," or "abutment pieces" and intervening or adjacent "dummies," the subject can doubtless be presented in the most practical and comprehensive manner by considering it from the respective viewpoints of, first, the application and construction of "attachments" or "abutment pieces"; second, the application and construction of the "dummies" which are to substitute the missing teeth, and third, the final "assemblage" of the various parts.

The presentation of each of these phases of the subject, however, may be properly prefaced by the consideration of a few general requirements which should invariably be observed, and which will be found to be productive of the best and most certain results, and thus, in the long run, to expedite the procedure.

Devising and Planning the Procedure.

The conditions of each case should be closely observed; the method of procedure which seems best indicated should be selected, and the bridge carefully planned before any of the actual work incident to its construction is attempted.

In this connection the observation of such requirements may be facilitated, particularly in extensive cases, by taking impressions and securing good models, the same to be used only as an aid to devising and planning the procedure.

Construction of Attachments.

When the method of procedure has been decided upon each and every "attachment," or "abutment piece" should first be made and completed separately, except, of course, that they need not be polished. This applies to any style of attachment with the exception of dowel crowns, in which instances only the cap and dowel should be thus completed, at least until all of the facings have been selected.

"Bite" and Impression.

The completed "attachments" or "abutment pieces" should then be accurately adjusted to position on the abutments, with wax or temporary stopping to sustain them in their proper relation, if necessary, and an accurate *occluding* "bite" in wax, and an impression in plaster then taken.

A *wax* "bite" is to be preferred to modeling composition or other materials, because of the ease with which it may be adjusted to the model without danger of breaking off the plaster teeth; and a *plaster* impression is *always* indicated because the employment of any material for this purpose which will *draw* perceptibly in removing from the mouth is not reliable, and hence the accurate replacement of the parts in such impressions is not insured.

Models.

Good reliable models of plaster should then be procured, the wax "bite" adjusted, and the case mounted upon the articulator.

In this connection plaster models are always preferable to those made of any of the investment materials, for the reason that strength and accuracy of outline are essential, and that such qualities are not possessed in the greatest degree by models made of investment materials.

Precautions Incident to Investing.

Before filling the impression the method ultimately to be observed in investing the case for final soldering should be noted. If the "abutment pieces" are to remain *in situ* upon the model, after trimming it down and investing, and during the process of soldering, which is

always advisable in extensive cases, it must be carefully observed that their interior is well filled with the plaster in pouring the model, in order to prevent air spaces which not infrequently result in fusing the parts during the process. If the "abutment pieces" are to be detached from the model, however, previous to investing, as is indicated in small cases, provision for facilitating the same should be observed by partially filling their interior with melted wax.

Mounting on Articulator.

All cases involving any number of the posterior teeth should be mounted and constructed upon some form of "anatomical" articulator, or one which at least affords some lateral movement. This is essential for the reason that many failures in bridgework can be attributed directly to faulty occlusion, and the success of all such cases will depend largely upon the degree of accuracy in this particular.

Construction of "Dummies."

Like the "attachment" or "abutment pieces," each of the intervening "dummies" should be *completed* previous to the final assemblage of all the parts. While this may seem like an unnecessarily circuitous procedure, its observance eliminates any possible danger of fracturing the porcelain facings during the process of the final soldering; or, of a change in the relation of the parts accruing from the shrinkage of so large a quantity of solder carried to the state of fusion at one time, and greatly diminishes the work incident to the final assemblage.

"Attachments" or "Abutment Pieces."

CHAPTER XX.

Attachments to the Roots of Teeth: Shell or Telescope Crowns; Application, Construction. Dowel Crowns, Application, Construction. Incising Natural Crowns of Sound Teeth. Attachments to the Natural Crown: Open-face Crowns; Indications and Contraindications, Application, Preparation of Tooth, Construction, Variation of Method, Fusible Metal Models, Seamless Method, Application to Molars and Bicuspids. Partial Crown Attachments: Indications and Contraindications. Application. Plate and Pin Attachments: Adaptation, Pins, Reinforcement. Groove Attachments: Indications, Preparation of Natural Crown, Construction. Inlay Attachments: Indications, Requirements, Cavity Formation, Construction. Taggart's Method of Casting. Telescope Attachments: Indications, Possible Objections, Possible Advantages, Construction. Temporary Attachments: Indications, Application. Occlusal and Lingual Supports: Occlusal Supports, Indications, Application. Lingual Supports: Indications, Application.

In the development of "fixed" bridgework innumerable methods of securing attachment to the remaining natural teeth have been devised, but as many of them have proven impracticable, only those of acknowledged usefulness and practicability at the present time will be presented.

These may be considered in two general classes: first, those wherein the attachment is made to the roots of the remaining natural teeth, and second, those wherein the natural crown of the tooth is conserved and the attachment made to it.

Attachments to the Roots of Teeth.

Irrespective of the desirability of conserving the natural crowns of those teeth which are to support the bridge wherever possible, and particularly in the anterior part of the mouth, the application of artificial crowns well adapted to the roots of teeth must be regarded as the best, most universally applicable and permanent means of attachment for "fixed" bridges.

Shell or Telescope Crowns.

Of all the methods employed the shell or telescope crown doubtless encompasses a greater sphere of usefulness and affords a greater range of application than any other one style of attachment.

Application. For cosmetic reasons, the application of this style of crown must necessarily be confined exclusively to the posterior teeth. In the upper arch such crowns should seldom if ever be used anterior to the second bicuspid, but in the lower arch where the teeth are usually less conspicuous they may occasionally be used as far forward as the first bicuspid. The flagrantly inartistic practice of employing such crowns on the cuspids or incisors, however, is unnecessary and unwarrantable, in any case.

Construction. When it has been decided that such crowns are implicated for attachments, the root or roots should be prepared, and the crowns constructed in accordance with the prescribed procedures as previously outlined.

As a general rule they should be completed in proper form first, as mentioned, and this is imperative in bridges involving more than three teeth, and particularly when two or more crowns of this style are employed in the same fixture, for the reason that the bands must otherwise be detached from and replaced upon the model so often as to possibly thereby endanger the accuracy of the final result.

Dowel Crowns.

Manifestly the next most important and generally useful method of attachment may be obtained from the employment of dowel crowns, and under this classification is included all of the various styles wherein a dowel is used.

When used as an attachment for bridgework, however, a narrow band encircling the end of the root should invariably be employed in preference to a simple plate adapted only to the basal surface, as the protection thus afforded will, doubtless, add to the preservation of the root, and the stability of the attachment. It must not be forgotten, however, that the success of a band depends entirely upon the degree of thoroughness observed in preparing the periphery of the root, and in adapting the band to it, in order to preserve a continuity of its surface, and thus avoid the possibility of irritation.

Application. The application of this style of crown is always indicated on the six anterior teeth, and for cosmetic reasons should invariably be employed on the first, and frequently on the second bicuspids, wherever the natural crown has

been wholly or perhaps even partially destroyed by caries, and where it may not seem warrantable or expedient to make an effort to conserve it, or its remaining portions.

Construction. Where dowel crowns of any style are to be employed as attachments, they should be made in accordance with the previously described requirements of root preparation, adaptation and construction.

The caps, including dowels, should be completed first, however, and the "bite" and impression then taken, and models procured. This admits of the proper selection and adjustment of the facings in their relation to the caps and to each other, after which the caps with their respective facings should be detached and soldered separately, previous to the final assemblage of the entire piece. For the reasons already mentioned, this procedure should be observed in all cases involving two or more crowns, and provision for their detachment from the model should be observed before filling the impression.

Incising Natural Crowns of Sound Teeth.

The question of sacrificing the natural crowns of sound teeth, particularly in the anterior part of the mouth, for the purpose of substituting artificial ones as supports for bridgework is undoubtedly highly important, and demands the most conscientious thought and deliberation on the part of the operator, for the reason that it is not within the province of our art to perfectly restore the natural condition.

It is quite generally conceded, however, that such a procedure becomes warrantable in proportion, first, to the disfigurement caused by the missing teeth; second, to the normal or abnormal position of such natural crowns in their relation to the adjacent teeth; third, to the absence of practical indications for other or better means of supplying the missing ones than by bridgework; fourth, to the inconvenience to the patient of wearing a partial denture, their natural abhorrence of the same, or the possible injury to the natural teeth that might result from abrasion, in their use; and fifth, to the ability of the operator to restore them in a practical, artistic and reasonably permanent manner.

While the age, and possibly the sex, of the patient has a material bearing upon the practicability of such a course, in any event, still we may often be justified in adopting such a procedure in at least two general classes of cases.

First, in those cases where an extensive bridge may seem indicated, and where a reasonably permanent style of crown is to be employed upon the other abutment roots. If all other abutment roots are to be treated

in a manner which will seem to offer greater opportunities than would likely be secured by any style or method of attachment other than a crown, one should not hesitate to sacrifice the natural crown of a tooth which is needed for support, and substitute an artificial one, as a means of affording greater strength to the entire piece and more artistic and permanent results, and particularly where the cutting off of one or two crowns of sound teeth makes possible the secure fixation of substitutes for several missing ones.

Second, in many of those not uncommon cases where conspicuous teeth have been lost through accident or from other causes, in an otherwise perhaps good and uninterrupted arch. By sacrificing the natural crowns of the tooth or teeth adjacent to the space, as the requirements may indicate, the missing ones may often be supplied in a "fixed" manner by attachment to the artificial substitute, with results more comfortable and serviceable, and less objectionable, inconvenient and embarrassing to the patient; and with artistic and permanent possibilities in proportion to the skill evidenced in the adaptation and construction of the work.

Attachments to the Natural Crown.

Under the classification of attachments to the natural crown may be included all methods other than artificial crowns, or, all of those wherein an effort is made to obtain adequate anchorage and fixation and yet conserve as much as possible of the remaining natural crown of the tooth so employed.

Whilst such conservation of tooth structure is manifestly a desirable procedure, and one which should be observed wherever the requirements and possibilities seem favorable, yet it nevertheless often happens that the natural crowns thus utilized are saved only for the time being, to be lost subsequently as the result of methods which are contraindicated, unreliable or inadequate.

Hence the employment of this class of attachments demands, on the whole, the exercise of rare good judgment, combined with the utmost of painstaking effort on the part of the operator, and will be successful only in proportion thereto.

Open-face Crowns.

Under this classification the so-called "open-face" crown, which, as the name implies, consists of a telescope crown with the "face" or labial surface so cut away as to expose as much as possible of this portion of the natural crown, has been perhaps the most generally employed method of attachment.

The real and practical value of this particular style of attachment, however, is always a question of very great importance for the reason that one of two conditions incident to, or arising from, their use does or may, result. Either less destruction of the natural crown than for any other style of attachment is demanded; or, an infinitely greater degree of destruction may result from their injudicious application, or faulty adaptation.

Of the several influences which may have been responsible for retarding the practicability and success of modern "fixed" bridgework, the very greatest one can doubtless be attributed to the indiscriminate and unskillful application of such attachments, particularly when they may be classed

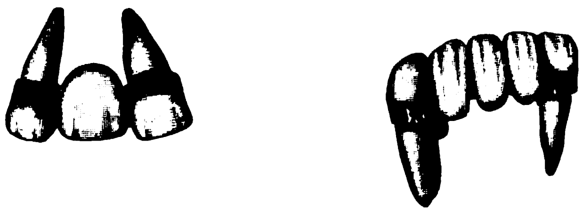


Fig. 243.

as simple bands, and more good, sound teeth have been lost, and more failures recorded through this pernicious practice than from any other one source.

Hence, the indiscriminate use of this class of attachments should be more or less generally condemned for the reason that their application may result in injury to, instead of conservation of, the supporting natural crown, and thus prove a menace to the possible success and permanency of the structure of which they form a part; and for the further reason that they are almost always conspicuously inartistic.

Two typical cases are illustrated in Fig. 243, where injudicious application and faulty adaptation of such attachments has ended in the loss of the supporting teeth. It is quite safe to prophecy such a result; or at least, the possible loss of the natural crown from hidden caries, if the adaptation be not accurate.

Notwithstanding these unfavorable features, however, there are occasional instances where this style of attachment may be indicated, and where its use may be productive of serviceable results in proportion as the fixture may be carefully adapted and properly constructed.

Indications and Contraindications.

The indications for the successful use of such attachments would always confine their application exclusively to the six anterior teeth, and particularly to the *upper cuspids,* and to the *lower cuspids*

and incisors, or, to those teeth where the normal shape and proportions of the natural crowns are more or less favorable.

The normal average inequality between the dimensions of the *crowns* and *necks* of the upper incisors, and of the bicuspids and molars, both upper and lower, however, usually demands so much mutilation of the natural crown in its preparation as to preclude their application to these teeth, or, at least to contraindicate their employment.

The fact that the application of this style of attachment admits of the telescoping principle, thereby answering the same purpose as an all gold crown without its objectionable features as applied to anterior teeth, and thus not demanding the sacrifice or excising of the natural crown, often makes it possible to secure a greater degree of strength in the attachment to the root, by thus distributing the stress over the entire length of the tooth, than would be likely to accrue from sacrificing the natural crown and substituting a dowel crown. This is a particularly advantageous feature in extensive bridges in which anterior teeth are involved, and especially in the lower arch where the roots are small, and yet, since it must be acknowledged that the attachment between such a crown and the supporting tooth is usually of a more or less temporary nature, due to the possible penetration of saliva into the exposed joint, and the gradual dissolution of the cement, great care must be observed in securing the most accurate adaptation possible, especially when it is to be used in conjunction with another style of attachment, such as a crown, which would perhaps offer greater permanency when cemented to place.

Applications.

If the application be confined to the class of teeth indicated; if the approximal surfaces of such teeth are properly trimmed so as to present parallel lines; if all other coronal proportions are reduced sufficiently to admit of the accurate adjustment of a crown and not a *simple band;* if the adjustment of the circular portion to the neck is accurate; if the entire lingual surface and incisal end of the tooth is so covered as to prevent the attachment from being forced root-wise; if the labial surface is so trimmed as to have as little gold show as possible; if all edges are then brought to "self-cleansing" points, and the whole then made strong enough to retain its shape, and admit of favorable occlusion with the opposing teeth, such attachments may be expected to offer reasonably permanent results.

Preparation of Tooth.

In the preparation of the natural crown for the reception of an attachment of this kind the paralleling of the approximal walls should receive attention first. If an adjacent tooth be present, adequate space should

be previously gained, and then the required trimming on each side may be easily accomplished with coarse disks, or very thin stones.

In this procedure it is necessary to remove only enough to admit of so reducing the coronal dimensions (Fig. 244 A) as to make possible the accurate adjustment of the crown to the cervix (Fig. 244 B), and care should be exercised to protect the adjacent natural crown, if one be present, from mutilation during the operation. The trimming of these surfaces should have a slight *lingual* tendency (Fig. 244 C), and should be continued until a measurement wire twisted taut at the cervix may be easily removed.

Fig. 244. b.

Fig. 244. c.

The *lingual* surface should then be ground away sufficiently to admit of the presence of the crown without interfering with the occlusion of the opposing teeth, and the *incisal end* should then be beveled lingually as a means of affording a definite edge to which this portion of the attachment may be finished, and a shoulder, which, when covered, will prevent its being forced root-wise beyond its proper relation. (Fig. 245.)

Construction.

In the construction of such attachments a thickness of gold should be used which may be easily and readily conformed to the tooth, but after being properly adapted, it must be subsequently reinforced in such manner as to insure adequate and uniform strength.

When the measurement has been taken with wire, as usual, a band of 29 or 30 gauge 22 K. gold should be cut of the same length as the measurement, and of a width greater, or, at least, equal, to the length of the natural crown from gum line to incisal end, and then made in circular form and soldered with 22 or 20 K. solder.

The cervical end should now be trimmed to follow the curvature of the gum, nicely rounded, and then fitted to this portion of the tooth, allowing it to pass a short but uniform distance beneath the free-margin. (Fig. 246 A.)

When the desired adaptation at this point has been secured, both the labial and lingual surfaces should be trimmed away as indicated in Fig.

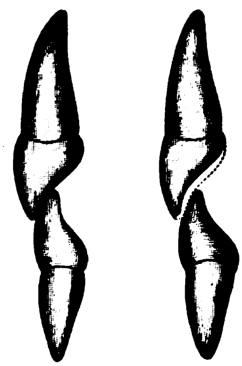


Fig. 245.

246 B. This reduces the exposed band upon the labial surface to the proper width, brings all labial edges to the desired point, to be self-cleansing, and allows the lingual band and *approximal surfaces* to be closely adapted to the tooth.

A piece of pure gold about 34 gauge should now be annealed and burnished to the lingual surface of the teeth, with this portion of the crown in place, until a close contact with the tooth and entire lingual edge of band, is obtained. (Fig. 246 C.) The two should then be removed, wired together, if necessary, and attached with just enough solder to effect union all around, during which the whole, and particularly the narrow labial band and pure gold back, may be uniformly reinforced upon the outer surface with the same karat solder. If the approximal surface of the attachment does not restore the contact point with the adjacent tooth, sufficient fullness to insure its restoration should be made at this time. This may be done with small pieces of plate gold, or with solder alone.

The crown should then be again placed in position on the tooth and finished with disks until the adaptation is completed (Fig. 246 D), when the final impression with it and the other abutment pieces in place may be taken.

Variation of Method.

A more simple method is sometimes employed, in which *only* the *labial* portion of the band is cut away after proper adaptation to the cervix has been secured, and the remaining lingual portion is bent down and burnished to place directly upon the tooth. By cutting out a V-shaped piece from the immediate center, this may be done, and, of course, saves material and does not require the attachment of a separate backing, but the adaptation is usually less accurate.

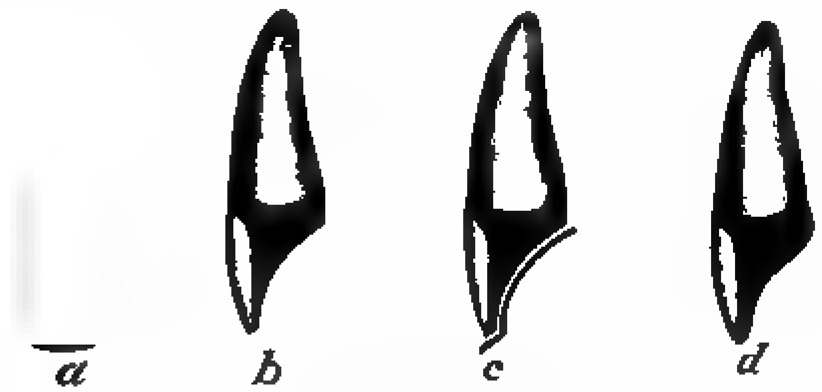


Fig. 246.

Fusible Metal Models.

The construction of such attachments upon fusible metal models of the tooth is also sometimes recommended as facilitating the procedure, but as the crown should pass slightly beneath the gum, such models are not accurate unless a *temporary* band of German silver or copper, so adjusted, and properly adapted, is previously fitted, and the model poured with this in place in the impression. Under such conditions a more or less accurate result may, of course, be obtained.

Seamless Method.

The seamless method, as referred to in Chapter VI may also be employed in the construction of such attachments, and this procedure affords an accurate fitting crown when the labial surface has been cut away—provided a temporary band has been previously adjusted—which is always necessary for the above-mentioned reasons.

Applications to Molars and Bicuspids.

While this style of attachment is sometimes employed on molars and bicuspids, such application is to be generally condemned for the reasons previously given. When used upon these teeth they practically become simple bands, and other more permanent means of attachment are possible and should be employed.

A variation of typical cases in which the application of the open-face crown would be more or less practicable are illustrated in Fig. 247. In these cases, it will be observed that such an attachment is used to support one or both ends of small anterior bridges, but only the anterior end of those involving the posterior teeth.

Fig. 247.

Partial Crown Attachments.

Ranking next to the open-face crown from the viewpoint of general usefulness may be considered that class of attachments which, while including nearly all forms of "plates," "inlays" and partial crowns, may be generally designated under the classification of partial crown attachments.

This class of attachments differs from the open-face crown in that as a general rule the telescope principle is not used, and hence the natural

crown is not completely encircled with a band. Thus only the lingual or linguo-occlusal surfaces are usually involved, and the fixation of the piece is secured to them by various mechanical means.

This avoids the necessity for the display of any gold upon the labial or buccal surface, and thereby makes such attachments *practically invisible,* which is always a desirable feature as applied particularly to the eight or ten anterior teeth, when it may be accomplished by means which will offer a reasonable degree of permanency.

The usefulness of any attachment of this kind, however, depends largely upon the same favorable indications for their employment, and the same degree of accuracy in their adaptation as has been described in connection with open-face crowns.

For this reason, while their judicious employment and skillful adaptation enables them to occupy a sphere of usefulness, like many other methods, and so-called systems, they are by no means to be regarded as being universally applicable, and hence they will be successful only in proportion as they may be judiciously used.

Indications and Contraindications.

The indications for any of these special forms of attachments, in general, would usually confine their application to the crowns of such teeth as may offer opportunity for accurate adjustment, as a means of supporting one or perhaps both ends of *small* bridges; of supporting *one* end of larger bridges when a crown is used on the other end, or of supporting a single missing tooth.

As compared with the possible longevity of a well-adapted full crown, however, such attachments, no matter how conservatively employed or skillfully adapted, while involving a less radical procedure, are usually to be regarded as being of a more or less temporary nature; yet instances of great permanency have been recorded.

Application.

While innumerable methods of obtaining suitable mechanical fixation to the natural crown have been suggested, many have proven impracticable, and hence only those which are regarded favorably will be considered. In the application of any of them, however, at least *three* cardinal features must be observed: *First*, the supporting natural crown must be so prepared as to admit of accurate adjustment to it and to the occlusion, and to afford adequate means for mechanical retention; *second,* this preparation must include an observation of the requirements of *parallelism,* which will admit of the ready adjustment of the structure of which it will subsequently be only a part, and *third,* the attachment must possess sufficient inherent strength to insure stability.

Plate and Pin Attachments.

As applied exclusively to the six anterior teeth, and particularly to the incisors, perhaps the best and most expedient attachment of this kind embraces the adaptation to the lingual surface of the natural crown of a simple plate with supporting pins.

Adaptation. In this procedure the tooth should be properly prepared, and a plate of 34 gauge pure gold then closely adapted to the entire lingual surface from just slightly beneath the cervix to the extreme incisal edge, and just far enough around

a

Fi,

the approximal surfaces toward the labial to bring the margins beyond the contact point, or to a self-cleansing area. It will be observed at once that this will require that these surfaces be so prepared as to admit of ready removal and replacement of the plate without danger of distorting its shape, a precaution very similar to that required for an open-face crown, as previously illustrated.

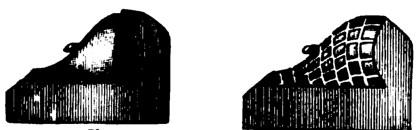
Pure gold should be employed because of the facility with which it may be closely adapted to the tooth, and the adaptation may be accomplished either by burnishing or by swaging on a fusible metal model or die of this portion of tooth, as may be preferred.

When the plate has been thus adapted and properly trimmed, anchorage to the tooth may be obtained by drilling two parallel pits into the center of the lingual surface on each side of the pulp (Fig. 248, A), just far enough to insure stability in the attachment, or as deep as possible without encroaching upon the latter (Fig. 248, B), with a round bur about the diameter of 18 or 20 gauge (B. & S.) wire.

The plate should now be adjusted to position and perforated with a

small, pointed instrument immediately over these pits, and pins made from iridio-platinum wire of the same size as the bur should be forced to place through the plate and into the pits (Fig. 248, C). The relation between pins and plate should now be temporarily sustained with hard wax or temporary stopping, and the parts then carefully removed from the tooth and invested, using only enough investment material to cover the pins and inside of plate. When the investment has hardened the temporary medium should be warmed and removed, and the attachment then well reinforced.

Pins. Since it is obvious that much of the stability of such attachments is dependent upon the integrity of the pins, and upon their close adaptation to the pits, the latter should be made with a bur of a diameter about the same as that



a b

Fig. 249.

of the wire of which the pins are made, in order that they may fit closely, and iridio-platinum wire should be used because of its strength.

Instead of using wire, however, a stiff and even more accurate fitting pin may be made by tightly packing any of the *crystal* golds into the pits after perforating the plate, and with it in position until they are completely filled and the gold overlaps the perforations, as suggested by Dr. J. E. Keefe. The overlapping of the gold upon the plate admits of the detachment of the whole, when the surface should be slightly reinforced with solder, without investing, in which procedure the pins will become so filled with solder as to render them stiff and solid, after which the attachment should be invested and the necessary additional reinforcement then given to the whole surface.

Reinforcement. Next to the strength of the pin, the stability of such an attachment will depend largely upon adequate reinforcement and stiffness. While 22 or 20K. solder, alone, may answer this purpose, such results may be obtained to the best advantage *whenever the plate extends around to cover the approximal surfaces* by carefully fitting to the *cervical end* a rim of clasp-metal about 30 gauge (Fig. 249, A), and after attaching it to the plate then completing the reinforcement over the entire surface as uniformly as

possible with a solder of sufficiently high grade to preclude subsequent re-fusion in the final assemblage of the parts.

It has been recommended that the entire reinforcement of such attachments be made by laying small pieces of clasp-metal over the surface, in consecutive layers, and uniting them with solder until the whole surface is flush and smooth (Fig. 249, B), which may be done with or without investing. This procedure gives a uniform thickness and a desired stiffness to the whole attachment, but as elasticity and stiffness is required mainly at the cervical end, in order that it may grasp the tooth firmly, the former procedure is regarded as the better and simpler process.

In any event the reinforcement must be adequate and more or less uniform, and the use of clasp-metal is imperative as a means of impart-

a *Fig. 250.* b

ing a degree of strength and elasticity such as is not to be obtained by the use of solder alone. When such reinforcement has been made the attachment should be removed from the investment, cleaned in the acid bath, tried to position upon the tooth and then finished to the point of polishing, as usual.

Groove Attachments.

Under the classification of *groove attachments* will be considered such procedures as require a more radical preparation of the natural crown for the purpose of obtaining increased mechanical fixation of the attachment.

The method previously described as the "staple" crown, probably first suggested by Dr. Wilbur F. Litch in 1888, together with what seems to be subsequent modifications of the original principle, as have been suggested by Dr. C. L. Alexander, of Charlotte, N. C., and Dr. J. P. Carmichael, of Milwaukee, Wis., may often be successfully employed.

Indications.

While this style of attachment is sometimes recommended as being applicable to almost any tooth in the arch, a conservative employment would seemingly confine its use *mainly to the cuspids and bicuspids*, or, as previously mentioned, to those teeth, the shape and normal proportions of which are favorable, and will readily admit of the required preparation.

Preparation of Natural Crown.

The preparation of the natural crown for the reception of such an attachment comprises cutting a groove across the lingual surface of the six anterior teeth at about the incisal one-third (Fig. 250, A), and then root-wise on the approximal surfaces to a close proximity with the gum line (Fig. 250, B).

Fig. 251.

These grooves form the mechanical retention, and should be cut just deep enough to afford a secure fixation of the attachment when in position, and must be placed in such relation to each other as to admit of the removal of the piece when closely adapted to them. Also, when two such attachments are to be used in one structure, the requirements of parallelism must be closely observed.

Evslin's Bridgeometer.

Perhaps the most ingenious of all paralleling and measuring instruments is the "Bridgeometer" devised by Dr. L. E. Evslin, of Paris, France.

In making the grooves in anterior teeth, if adjacent teeth are present, *ample* separation must first be obtained, and it should then be noted that the occlusion of the opposing teeth will, or is made to, accommodate the presence of the attachment when in position. This may, of course, require either that the lingual surface of the tooth or the incisal ends of the

opposing teeth be sufficiently ground to afford such accommodation, as previously illustrated in Fig. 245.

With a thin knife-edge stone a groove should now be cut from the mesial to the distal surface at about the point indicated, and then at right angles from this groove the approximal grooves should be formed with a short cross-cut fissure bur.

In bicuspids or molars ample space must also first be gained, the lingual cusp then ground down to afford a flat, square base for the attachment, and the occlusal groove then cut up close to the buccal cusps, this to be followed in turn by the cutting of the approximal grooves. (Fig. 251.)

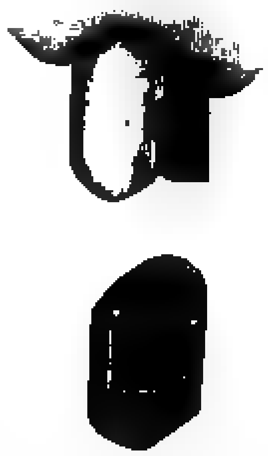


Fig. 252.

Fig. 253.

While these attachments are, of course, more or less applicable to the molar and incisor teeth, the shapes of the crowns of these teeth are usually so unfavorable as to demand considerable mutilation in effecting the required preparation for an accurate adjustment, and indeed, for this reason it will doubtless be found that the process will most often be restricted to the upper cuspids.

Construction.

In the so-called "staple" or "hood" method a piece of round platinum wire, about 18 gauge, is first closely adapted to the groove, and thin, pure gold, 34 to 36 gauge, then burnished over this and trimmed to the desired outline of the crown. The two are then removed, and the wire "staple," remaining in the depression formed in the gold by it, is attached with solder, after which it may be invested and properly reinforced. (Fig. 252.)

In the so-called "Carmichael Attachment" the wire staple has been

abandoned, and the gold is burnished directly down into the groove. To prevent tearing and to facilitate the removal of the gold the margins of the grooves should be slightly beveled. A ribbon of pure gold about 38 gauge should be placed around the tooth and first carefully burnished into the grooves with a suitable instrument. When well adapted to these points, it should be trimmed and carefully adapted to the entire lingual and approximal surfaces, as described in the former method, in which the procedure may be facilitated by tying it to the tooth with a ligature or holding it securely against the tooth with a piece of tape.

If the gold is perforated in being adapted to the grooves such places should be filled in with any of the crystal golds, and when the adaptation is thus completed the attachment should be carefully removed.

As a provision against the possible penetration of solder to the under surface, in the event of perforations, it is well to paint this surface with a thin coat of whiting and alcohol just previous to investing, after which the attachment should be reinforced in the manner previously described in connection with "plate and pin" attachments. While this may be done without investing, it is nevertheless always a more reliable procedure, and also affords opportunity for the proper adjustment of the cervical rim of clasp-metal. After this rim is attached with solder, the grooves should be filled with small pieces of clasp-metal, and the whole then uniformly reinforced with a grade of solder which will not be re-fused in the final assemblage of the parts. The completed attachment and its relation to the supporting tooth is shown in Fig. 253.

While fusible metal models may be obtained from gutta-percha or modeling compound impressions of the tooth, and used in the preliminary adaptation, the *final* adaptation should always be done directly upon the tooth itself. Such attachment may also be made by *casting*, using clasp-metal, as suggested by Dr. Taggart, and as described in detail in connection with *inlay* work.

Inlay Attachments.

A still more radical method, in so far as the destruction of the remaining crown is concerned, is involved in the employment of various forms of "inlays" as attachments for the support of bridges.

In view of the apparent tendency toward this class of work, particularly in the filling of teeth, it would seem that such attachments are undoubtedly destined to occupy a more or less prominent sphere of usefulness, and, indeed, as applied to supporting small bridges of two or three teeth, or to supporting one end of even more extensive pieces, they may often be used with every assurance of success and permanency.

Indications. The indications for the use of this class of attachments usually demands a more extensive general, in proportion as the conditions may seem favorable; and, while they may be applied to almost any tooth in the arch except perhaps the lower incisors, they are more readily applicable to pulpless teeth; or to those teeth where devitalization of the pulp for the purpose of making suitable cavities may seem warrantable, or where cavities or fillings involving the approximal surfaces adjacent to the missing teeth are already present.

Requirements. As the most successful application of such attachments may be regarded as being more or less destruction of the natural crown than is required for any other similar form of anchorage, the removal of the pulp is usually necessary as a means of properly preparing the crown for the reception of an inlay which may not only be properly adapted, but which may also offer sufficient strength to insure a reasonable degree of permanency.

While the removal of the pulp in anterior teeth, where the natural crown is to be preserved, may possibly be condemned because of the subsequent discoloration which *may* result, yet such a discoloration is invariably the fault of the operator, more than of the procedure, and may usually be avoided if the proper precautions are observed.

In molar and sometimes in bicuspid teeth having crowns of *good proportions,* however, and where the ravages of decay have already resulted in cavities of more or less favorable shape, size and position, adequate preparation may sometimes be obtained without encroaching upon the pulp or otherwise exercising an influence injurious to its vitality.

In such instances, devitalization may not be necessary, but, as the inlay must involve the *contact point of the natural crown* to such extent as to bring all of its margins to a *self-cleansing area,* and must then be of such shape as to be *mechanically retained* in the cavity, and of such proportions as will *insure strength in its attachment,* it will usually be found that the removal of the pulp is either advantageous or imperative.

Cavity Formation. The success of this method of attachment will depend largely upon cutting, or enlarging, the cavity until it involves such proportions as will bring all margins to a self-cleansing area—or to a point on all surfaces beyond that of contact with the adjacent artificial tooth which is to be supported —and, to such as will also insure adequate mechanical fixation and strength in the inlay.

The requirement of mechanical fixation demands resistance to stress in a direction tending to dislodge it; and that of strength demands that

it be of considerable size. Hence, when the employment of this method seems indicated conservation of tooth structure is second in importance to the stability and permanency of the attachment.

Generally speaking, the cavity must also have a flat base, from which the axial margins should be trimmed at right angles, or slightly diverging toward the periphery. It should then be *free from vertical*

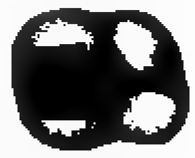


Fig. 254.

undercuts which would preclude the insertion and removal of the inlay, and have *smooth definite* margins, such as will make possible and insure a close and accurate adaptation.

To further fortify the attachment against the possibility of dislodgment, when subjected to stress, the insertion of a *short, stout* dowel is recommended wherever possible. If the depth of the cavity is sufficient,

Fig. 255.

and its formation provides such mechanical resistance to stress as will preclude dislodgment, the employment of a dowel is, of course, not necessary, yet these requirements are usually best met by its use.

Such cavity preparation in two typical classes of cases involving the linguo-approximal surfaces of anterior teeth, and the approximo-occlusal surfaces of posterior teeth is illustrated in Fig. 254.

Construction. When the cavity has been thus formed, a matrix of pure gold 36 or 38 gauge (or of platinum foil 1-1000 if preferred) should be closely adapted to all surfaces and margins. This may be accomplished directly in the cavity with pledgets of cotton, or of spunk, and suitable burnishers. Or, an impression may be taken with gutta-percha or cement; a die of cement or amalgam made from this, and the preliminary adaptation secured by swaging with the Brewster, or other soft-rubber plunger swaging devices, but even in the latter method the final adaptation should be made to the cavity itself.

When the matrix has been properly adapted, the surplus should be

Fig. 256.

trimmed away until only a narrow margin remains, and if a dowel is to be employed the matrix should be removed and the cavity at this time deepened root-wise, at the desired point, for its reception. In this, care must be exercised to have a small, stout dowel pass but a short distance into the pulp chamber, and at right angles with the floor of the cavity, so as to prevent its presence from interfering with the removal and ready replacement of the completed inlay.

The matrix should now be filled with soft wax (because of its easy removal afterward) to preserve its shape and sustain the relation between it and the dowel; detached from the tooth; invested, and subsequently filled to the desired contour, first with *globules* of scrap gold, and then with 22 k. solder, after the investment has become hard and the wax removed.

While the best results are doubtless to be obtained from the use of pure gold of the gauge mentioned for the matrix, and by contouring in

this manner, some prefer to use platinum foil. The extreme thinness of the latter diminishes the work incident to the final finishing upon the tooth, but increases the tendency to become distorted in shape in removing and investing. To prevent the latter, Dr. C. C. Allen, of Kansas City, has suggested filling the matrix before removing with *gum camphor*, which may be burned out easily after investing, or a medium hard wax may be used, for the same reason. The adjustment of an ordinary circular matrix to restore the approximal wall, and the filling of the entire matrix for the inlay with crystal gold previous to subsequently investing and finishing with solder, is also recommended and may be found useful in some cases.

Taggart's Method of Casting.

A method of constructing gold inlays which reduces the procedure to a system of scientific mechanics, and which is so simple, expeditious, certain and accurate as to seem destined to practically supersede all former methods of making *large* restorations, has been devised by Dr. W. H. Taggart, of Chicago.

In this process the inlay is made by *casting*, and for the reason that gold inlays which are to be used as attachments for bridgework must usually be large, and always accurately adapted to the cavity, and to the occlusion, the method seems particularly applicable, and quite ideal. The possibility of using pure or high-grade gold also allows more freedom in soldering.

Procedure.

In the procedure, when the cavity has been prepared in accordance with all of the requirements it is coated with liquid vaseline and filled with a special dark colored *wax*, into which the patient is required to bite. This forces the wax well down into the cavity, and conforms it to accommodate the occlusion. It is chilled with a spray of cold water, and then slightly loosened, or unseated, with a pointed instrument, after which the patient is again requested to bite, thus firmly forcing it back into place.

Forming Wax Filling.

The wax is now again chilled, carefully removed with a pointed instrument, and trimmed and carved to the desired outline of the completed filling, during which it may be replaced in the cavity from time to time, but must be handled gently, and kept at a suitable temperature by means of dipping in cold water. It is also necessary to keep the cavity, instruments and fingers perfectly clean during this

procedure in order to preclude the presence of foreign substance in the wax.

When the wax filling has been thus formed and trimmed, it should be replaced in the cavity, and all overhanging edges carefully removed and the adaptation to the margins perfected. This may be done by coating a strip of the thinnest tape with vaseline and drawing it backward and forward over the approximal and cervical margins, in much the same manner as a finishing strip is used, and then by wiping over the occlusal margins with a pledget of cotton also dipped in vaseline.

This technique is important in every detail and must be closely observed, as the slightest imperfections will be reproduced in the gold, and, therefore, the finished filling can not be any more perfect than the wax one.

The wax used is a composition of wax and parafin, thoroughly filtered in order to be free from foreign substances.

Investing.

When the wax filling is thus finished it is chilled, carefully removed and immediately invested. In the latter procedure one end of a piece of round wire, about 12 to 14 gauge, which is to be used as a sprue-former, is slightly heated and then gently attached to the center of the wax, after which a small quantity of a special investment material is mixed and then carefully packed into, over and around it until the entire filling is completely submerged, with the exception of the end of the sprue-former, by which it has been held with the fingers.

This preliminary investment is thus made in order to prevent air spaces adjacent to the wax, and when it has crystallized the whole is finally invested in the casting flask.

The latter is a heavy brass ring which engages in a flat base, having an elevation in the center and a perforation in the center of this elevation.

Flasking.

The exposed end of the sprue-former is now inserted in the perforation in the base of the flask, the ring adjusted to position thereon, and the whole then filled with investment material. After crystalization the base is removed and the sprue-former gently pulled out. This leaves a depression, or crucible, formed by the elevation, and a channel leading from it to the wax, formed by the sprue, and a mould of the wax filling, all combined in one piece.

Casting.

The mould is now placed over the Bunsen-burner and slowly heated until the wax is burned out and absorbed by the investment material, after

which it is thoroughly dried and heated, and then transferred to an ingenious automatic machine, which, among other features, embraces a small oxy-hydrogen blow-pipe.

An ingot of pure, 22 k., or coin gold is now placed in the crucible and fused. When carried to a degree considerably beyond the melting point, a lever which automatically cuts off the flame and hermetically closes the top of the mould, is operated, and the melted gold is simultaneously forced into the mould by the pressure from the gas cylinder.

When the casting is made, the flask is removed and plunged into cold water, after which the stem of surplus gold is separated with a small saw and the filling finished. Very little finishing is required, and the result is an accurate reproduction of the wax, however perfect or imperfect it may have been.

Variations. The so-called "hollow" inlays, or any irregularities of the cavity surfaces for the purpose of facilitating anchorage to the tooth, may be made by carving the wax; and "pins" or "posts" may also be provided by first fitting them to the cavity, with as much surplus as occlusion and contour will admit, and allowing them to become a part of the wax filling, using clasp gold or iridio-platinum wire of the desired size. These are held securely in the investment and subsequently become an integral part of the casting.

General Application. This method is not only applicable to inlays, but to backings for all forms of diatoric or replaceable teeth, to caps for crowns, and to removable bridges and even partial dentures; and 25 per cent. platinum solder, clasp-metal, or any of the alloys of gold, or even silver or copper may be used. Indeed, its application seems practically unlimited, and to be restricted only by the requirements of a suitable investment material, and the size of the flask, which future development will doubtless afford.

Final Requirements. When the construction of the inlay by either of these methods has been completed, it should be placed in position in the cavity and finished with stones and disks until the desired adaptation and a proper occlusion has been obtained, when the final "bite" and impression should be taken. The completed inlays for the typical cavities previously illustrated are shown in Fig. 255.

A class of cases in which molar teeth have tipped forward until their occlusion is destroyed, which are encountered frequently, and particularly in the lower arch, and to which this method of attachment is especially

applicable as a means of affording anchorage for a bridge, and at the same time of restoring the occlusion, is illustrated in Fig. 256.

Another class of cases involving the employment of the "inlay" attachment on the posterior end, in conjunction with the "plate and pin" attachment on the anterior end, is illustrated in Fig. 257. The application

Fig. 257.

of each attachment in its respective place is typical, and, next to full crowns, this is regarded as being one of the best, most practical and highly artistic means of supplying missing bicuspids.

Telescope Attachments.

The telescope attachment is sometimes employed upon the molar and bicuspid teeth in the shape of partial gold crowns, involving only the occlusal one-half or two-thirds of the natural crown.

Indications.

While this method requires but a minimum of cutting of the natural crown, and may be useful in instances where the attachment is not conspicuously visible, where the teeth so employed stand alone, and without opposition from occluding teeth, in the arch, or where only a more or less temporary structure is required, still at best they are indicated as an expediency rather than as a general practice.

As they are not intended to pass beyond the most bulbous portion of the natural crown, about the only preparation necessary to their adjustment is the removal of enough of the occlusal surface to admit of cusps of sufficient thickness to withstand any stress of mastication to which they may be subjected.

For this reason their employment is usually confined to teeth having vital pulps and where it seems desirable to preserve this vitality, for, if the pulp should or may be sacrificed, there would be no apparent reason for not properly preparing all surfaces of the natural tooth and adjusting the usual style of artificial crown to it.

Hence the use of such an attachment can only be regarded as a means to an end, and the end is to save the pulp; but if a fixed bridge is indicated at all, this objective point is secondary to its fixation in the most secure and permanent manner possible.

Possible Objections.

On the other hand, however, they may be useful as a means of supplying missing teeth in the mouths of very young patients, where, because of the lack of root development, it may not seem warrantable to devitalize the pulp or to subject the tooth to the shock of more extensive preparation such as would be indicated for a complete crown.

In these instances such attachments would be expected to serve, in the main, but a temporary purpose, and thus only defer a more permanent procedure until a more favorable time.

Construction.

Whenever indicated this style of attachment, which is illustrated on the molar teeth in conjunction tion with "inlay" attachments on the bicuspids, in Fig. 258, should be constructed in accordance with the general requirements previously outlined for a full crown, except, of course, that any peripheral preparation of the natural crown is unnecessary.

For prophylactic reasons it should be observed, however, that the surface of the attachment which approximates the adjacent artificial tooth be allowed to extend sufficiently far beneath the contact point with the latter, so as to leave a free interproximal space, and thus make it more or less self-cleansing. (See Fig. 258.)

Temporary Attachments.

Incident to the correction of irregularities of the teeth, the modern scientific practice of orthodontia and the recognized importance of a full complement of teeth in the restoration or preservation of the normal occlusion, not infrequently demands the application of some form of dental bridgework to the mouths of *young* patients, as a means of supplying missing teeth, and of, perhaps, temporarily, but securely, retaining the natural teeth in their proper position.

Indications. The exigencies and varied requirements of such cases, together with the unfavorable age of the patient, usually indicates the employment of appliances which may be securely "fixed" to the supporting teeth, and

Fig. 258.

yet in the mouths of patients under fourteen or fifteen years of age no effort toward a radical procedure which would materially mutilate the natural teeth is usually indicated or should be attempted, because of the more or less imperfect development of the roots, and of the difficulties otherwise involved in the procedure.

In such cases the missing teeth should usually be supplied in the most simple manner possible until such time, at least, as the environment and conditions may be more favorable for securing a greater degree of permanency.

Up to the age of perhaps fifteen or sixteen, this would usually indicate the employment of simple bands as a means of attachment for the support of artificial teeth, and in their application care should be exercised to avoid any shock to the pulps of the teeth so employed, and to place such bands around the natural crowns at their largest circumference in order that no possible mechanical irritation may result.

Application.

In the application of such bands about 32 gauge 22 karat gold should be used, and in the adaptation to the anterior teeth the exposed labial portion may be made extremely narrow, but the lingual portion should cover enough of the natural crown to admit of the use of a sufficient quantity of cement in

Fig. 259.

Fig. 260

mounting to insure a degree of stability in the attachment which will prevent its being forced rootwise, or otherwise displaced (Fig. 259).

On the posterior teeth, however, a further precaution against such displacement should be observed by the addition of an *occlusal rest* as a part of the band (Fig. 260). In the event of the latter interfering with the occlusion accommodation must be made by grinding the tooth at these points, or else the opposing teeth.

Appliances of this character are of course only temporary in nature, but when properly adapted and securely mounted with cement, they may support one or two teeth, and thus serve the desired purpose, until such time as a more radical preparation, and more permanent method of fixation, may be indicated.

While *removable* appliances may be employed in such cases, they are not so reliable, and are not usually to be recommended, because of the difficulty of learning to wear them; of the tendency to forget, misplace or lose them, or of the possibility of swallowing them.

Occlusal and Lingual Supports.

While it is quite logical to suppose that attachments for bridges which are to be securely anchored to the teeth must, of necessity, be more or less permanently fixed in their relation to the supporting natural crowns, there are nevertheless instances where a simple *rest* or *support* may be found exceedingly useful, and where the judicious employment of such rest will answer practically the same purpose, as far as the requirements are concerned, as would any of the preceding methods of attachment.

Occlusal Supports.

This is particularly true of a style of support which, because of being applicable mainly to the posterior teeth, and of then involving only the approximal and occlusal surfaces of the natural crown, may be properly designated as "occlusal" supports.

Indications.

As there is a marked line of distinction between *anchorage* and *support,* and as all fixed bridges must be securely "anchored," the "judicious employment" of any style of "support" would necessarily mean that it could be used *only* in conjunction with one or more other methods of "anchorage" or attachment.

Hence, in small bridges where but one or two teeth are to be supplied, and where any of the preceding methods of attachment are used as the anchorage for one end, if the strength and stability of the attachment itself seems adequate to the requirements of anchorage, a simple support on the other end may be all that is required to insure reasonable permanency in the structure.

Also, in more extensive bridges involving *two or more attachments,* which seem to offer a stability adequate to the requirements, and yet where it may be desirable to extend *one,* or in some exceptional instances *two,* teeth, either anterior or posterior to one of the attachments, a simple support may answer for the extreme end of the extension.

Application. Such a support may be obtained, when indicated, in a manner which will require but comparatively little destruction of the natural crown thus used, and yet which will afford adequate resistance to *lateral* and *vertical* stress, and at the same time produce a cosmetic effect, by making or utilizing a cavity in the approximo-occlusal surface of the natural crown

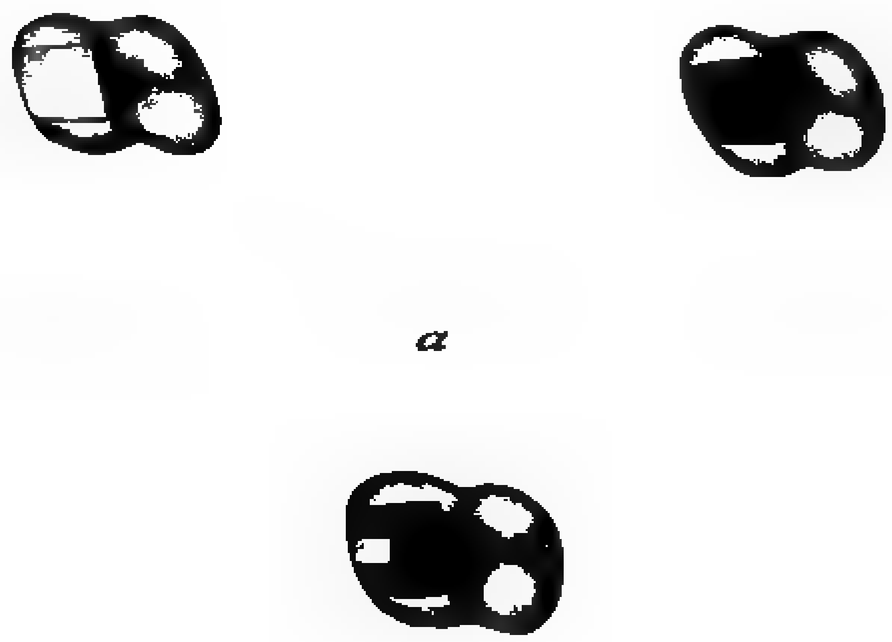


Fig. 261.

(Fig. 261, A): filling and finishing it in a permanent manner *first* (Fig. 261, B), and then cutting a seat in the center of the filling which will offer accommodation for the end of a suitable bar projecting from and forming a part of the bridge (Fig. 261, C).

For prophylactic reasons such a cavity must be extended sufficiently far so as to bring its margins to immune areas, and to such proportions as to admit of the subsequent cutting of a seat in the filling which *will not involve any of the margins*, and yet which will receive the projecting end of a *square* iridio-platinum wire about 16 gauge. When the filling is inserted, finished and polished, the seat may be cut in it with a cross-cut fissure bur of the same diameter as the wire to be used. This should be done after the other attachment, or attachments, is, or are, made, and then with them in position the wire should be fitted into the seat and

allowed to extend over until its other end rests against the attachment. When the proper relation is thus secured and insured the final "bite" and impression may be taken.

Dr. Ottolengui advocates the following method of constructing an occlusal rest. A filling is made and finished first, as already described. The slot or seat is then cut and is constructed with a flat bottom and very slightly flaring sides. Into this slot is then burnished a piece of thin pure gold which is brought into a close adaptation with a smooth flat end burnisher and a mallet. This gold is also carried over and burnished against the approximal surface of the filling extending slightly below the

Fig. 262.

contact point. Into this is then fitted the iridio-platinum square post, the two waxed together, removed, invested and united with 20 karat solder. This is then returned to the mouth and fitted and soldered to the attachment, as already described in connection with the simple bar. The advantages claimed by Dr. Ottolengui are a more firmly setting rest, which not only makes a cleaner appliance, but being burnished also against the approximal surface, may be made to serve slightly as a lock, the finished piece snapping into place. The final finishing of the occlusal rest should be made with the piece in the mouth, so as to make it continuous with the filling in which it rests, and thus smooth to the tongue.

This projecting end need only rest firmly and snugly in position in the filling, and no effort should be made to attach it more securely than is thus to be obtained by such a fit. Indeed, if the fit of the projecting end of the wire into the seat in the filling is at all close it will rest quite firmly therein, thus supporting that end of the bridge against vertical and lateral stress, and the slight degree of mobility afforded will be found ad-

vantageous instead of objectionable. When used to support two teeth, however, where the leverage is so appreciably increased, it is usually a safe precaution against the possibility of loosening the attachment at the other end, to warn the patient to avoid the constant or too frequent use of hard, sticky substances.

While the advantages to be obtained from the employment of such a support are quite sufficient to even warrant the cutting of cavities in sound teeth, still the method is more particularly applicable when a cavity already presents. The typical application of this principle to the *support* of the posterior end of small bridges which are otherwise securely anchored, is illustrated in Fig. 262.

Fig. 263.

The former practice of extending projecting bars into cavities and of subsequently inserting the filling over and around them after mounting the bridge, has practically been abandoned, because of the extreme difficulty of making a permanent filling under such conditions, and of the consequently temporary nature of attachments made in this or a similar manner.

Lingual Supports.

In a preceding consideration of the underlying *principles* particular attention has been called to the necessity for employing some mechanical means of overcoming leverage *where one tooth is to be suspended from another,* and of thus preventing rotation of the supporting tooth on its long axis.

In so far as concerns the application of this principle to the construction of such bridges anterior to the second bicuspid this may be accomplished by the employment of what may be designated as a lingual support.

Indications.

The indications for the employment of such supports are general as applied to the construction of bridges where a single tooth is suspended from a single attachment, anywhere anterior to and including the second bicuspid, for the reason that the roots of the incisors, cuspids and bicuspids

are of more less conical shape, and, hence, unless fortified against rotation, will invariably succumb to the power of the lever, and ultimately become so twisted on their long axis as to result in the presentation of a space between the suspended artificial tooth and the adjacent natural tooth, much as a gate swings on its hinge from the direction in which the force is applied, and as is illustrated in Fig. 263.

Application. In the application of such supports, however, their practicability or impracticability will depend largely upon the following conditions: *First*, an adjustment which will not interfere with the occlusion of the opposing teeth.

Fig. 264.

nor impinge upon the soft tissues; *second,* an adjustment which will be sufficiently free from contact to maintain as nearly a *self-cleansing* space *between it and the tooth and gum* as possible; *third,* an adjustment which will afford only a *minimum* contact with the tooth against which it rests, and *fourth,* the possession of sufficient rigidity to withstand the stress imposed (Fig. 264).

If these requirements are observed such supports need not afford much, if any, opportunity for the occurrence of caries at their point of contact with the natural crown; need not be appreciably unhygienic, nor an impediment to the movements of the tongue, nor to speech.

In order that they may possess sufficient rigidity and strength, nothing smaller than 16 gauge round iridio-platinum wire should be used, and the adjustment may be made upon the model before the case is invested, or after it is invested if the following precaution is observed. When the anchor attachment and dummy are completed and they are ready to be

invested and united, the proper relation should be sustained with hard wax. A small quantity of soft wax should then be attached to the lingual surfaces of the pieces and pressed against the same surface of the adjacent tooth on the model. This will afford an impression of this surface of the tooth, so that when the case is detached from the model and invested, and the wax is removed, an accurate outline of this surface of the tooth against which the support is to rest, will present in the investment.

Fig. 265.

The support may then be adjusted, as indicated, placed in position, and the case heated and soldered.

In finishing, the end of the support should be nicely rounded down toward the tooth upon which it is to rest, and before mounting it should be observed that it offers no interference to the occlusion, and no unnecessary obstruction to the tongue.

The application of this class of supports showing their correct relation and possible effectiveness in such typical cases, for example, as a second bicuspid supporting a first bicuspid, and a central supporting a lateral, is illustrated in Fig. 265.

Application and Construction of Dummies.

CHAPTER XXI.

Application and Construction of Dummies: Anterior Dummie; Selection of Facings, Adaptation, Backing. Artificial Restoration of Gum. Posterior Dummies; Porcelain Faced Bicuspids and Molars; Application, Selection of Facings, Backing, Occlusion, Carved Cusps, Attaching Facing and Cusps, Continuous Cusps, Die-Plate Cusps. All-Gold Dummies; Indications, Construction. Occlusal Surface Dummies; Indications, Construction. Lateral Gravitation: Correction of Malposition, "Attachment" and "Dummy" Combined. Opening of the "Bite": Elongation, Abrasion, Typical Application.

An effort toward a systematic presentation of the various methods of "attachment" and "support" for "fixed" bridgework, is necessarily followed by a consideration of the construction and employment of the "dummies" which are to be attached thereto, and which are to act as substitutes for missing teeth, thus, in a general way, forming the "body" of the bridge.

In the development of this class of work any number of designs of artificial teeth have been introduced, but only a few are, at the present time, regarded as applicable, and more or less generally applicable.

Anterior "Dummies."

In supplying missing teeth anterior to, and often including the first bicuspid (where an occlusal surface is seldom required), the ordinary long-pin, "flat-back" facing, is generally used.

Selection of Facings.

In the construction of bridges involving anterior teeth, the facings which are to substitute the missing teeth should be selected as soon as the final model with the "attachments" in place, has been secured.

(Fig. 266.) In their selection it should be observed, *first,* that they fill the space between the attachments; *second,* that they are as nearly as possible proportionate in size, *as to length and width,* with the crowns of the remaining natural anterior teeth not included in the bridge; and *third,* that the color closely resembles that of the natural teeth. In this latter connection it must be remembered that the presence of the metal backing always darkens the shade of the facing, and also, that in the event of not

Fig. 266.

being able to perfectly match the shade, one slightly darker is invariably preferable to one the least bit lighter. It is also well to consider the variations in the shade of the natural teeth in the same mouth, as previously mentioned, and to make the selection accordingly.

Adaptation. As soon as the desired selection has been made, a small roll of soft wax should be sealed to the model, and the facings then ground until their necks are perfectly fitted to the gum, and then until they nicely fill the space without

being in absolute contact with each other. The latter requirement is necessary as a means of preventing impingment from the shrinkage of the solder in assembling, which if not observed, might result in fracturing the porcelain.

When the neck of the facing has been closely adapted to the outline of the model, the extreme edge should always be rounded until blunt and smooth, in order that no irritation to the soft tissue may thereby be offered.

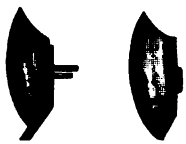


Fig. 267.

As it is necessary for cosmetic and hygienic reasons that the end of the facing should rest in direct contact with the gum, this feature must be observed, or inflammation and often hypertrophy will result.

Backing. When these requirements have been observed the incisal or occlusal end of the facings should be beveled to a more or less thin edge, and a double, or otherwise well reinforced backing then adapted in accordance with the requirements in this connection, as previously outlined for single crowns, except that the backing should never extend to the extreme cervical end, nor be allowed to interfere with the direct adaptation of this end of the facing to the gum. (Fig. 267.)

When allowed to project beyond the cervical *shoulder* on the facing, its presence offers no protection to the porcelain, but only interferes with the accuracy of the desired adaptation to the gum, and, unless amply reinforced, would be likely to draw away from the porcelain and thus produce a joint or pocket for the accumulation of secretions which would be decidedly unhygienic.

When double, or well and otherwise uniformly reinforced backings are thus adapted and securely retained to the porcelain by bending the pins, they should be separately finished with files or stones, and then, even with fine disks to the point of polishing, in order to preclude the possibility of overhanging edges.

Artificial Restoration of Gum.

It has already been observed that, for cosmetic reasons, *the artificial tooth should always be of the same exact length as the crowns of the adjacent or corresponding natural teeth,* yet the excessive absorption frequently found to exist where bridgework is indicated often precludes this, or demands the special preparation of facings, or the employment of gum-block teeth.

d.

Fig. 268.

While gum-block, long-pin teeth may sometimes be selected, properly ground and used to good advantage in this class of cases, still the demand for them is not great enough to warrant their being manufactured in large numbers, or in great variety, and hence it may frequently be necessary to select a plain tooth, and build a neck of gum-enamel upon it.

This may be done in a most artistic manner by mixing any of the gum-enamel porcelain "bodies," of the proper gum-color, to a thick consistency, and building an extension upon the neck of the facing or facings, of proportions which will admit of being ground to the desired adaptation after fusing.

In observing this procedure a facing of the exact length of the ad-

jacent natural crowns (Fig. 268, A), or one even longer if prepared by grinding a shoulder at the proper point (Fig. 268, B), should be selected, and the gum-enamel then built on and fused, after which it may be ground to the desired adaptation (Fig. 268, C), and one fusing is usually all that is necessary. The possibilities in this connection as applied to the anterior teeth are illustrated in Fig. 268, D, and as applied to the bicuspids have been previously illustrated in Fig. 257.

Posterior "Dummies."

The requirements incident to the application and construction of dummies for the posterior part of the mouth, where masticating surfaces are necessarily involved, present phases of a much more varied and complex character.

This is due largely to the more diversified conditions of absorption and occlusion which are encountered in this part of the mouth, and which will in turn govern the indications for the application of any of the methods used.

The requirements of contact between the necks of artificial teeth and the gum tissue, while perhaps not so exacting as compared with the eight anterior teeth, for purely cosmetic reasons, are nevertheless an important consideration, and may be summed up in general by the statement that the same accuracy of adaptation as applied to the anterior teeth should *obtain,* or else there should be *no contact* at all, and this applies both to the facings, or to the body of the bridge, as the case may be constructed.

Porcelain Faced Bicuspids and Molars.

Perhaps the most generally applicable and commonly used style of construction for bicuspid and molar "dummies" consists in using long-pin, "flat-back" porcelain facings in combination with an occlusal surface of gold.

Application.

The use of this particular method is indicated wherever the cosmetic requirements demand the presence of porcelain, and yet, where the demands for strength seem to contraindicate the employment of *all-porcelain* bridges—and while it is very apparent that even an occlusal surface of gold is more or less objectionable on any of the twelve anterior teeth, still the fairly esthetic results, combined with the possibilities for strength, and accuracy of occlusion, make such a type of construction quite generally useful.

Selection of Facings. In selecting the facings it will often be found that those designed for the *cuspid* teeth can be used to better advantage for bicuspid dummies, than can the "bicuspid" facings which are made for the purpose. A color somewhat darker than the anterior teeth should always be obtained, and in order that as nearly uniform proportions as possible may prevail, it is usually better, for example, to fill a given space with two

Fig. 269.

facings of fairly good size than with three small ones; better for two reasons, first, because the size will usually correspond more closely with that of the remaining natural teeth, and second, because less grinding will be necessary, and hence, greater strength will result.

Backing. When the facings have been selected and ground to the proper adaptation to the model, and with an allowance for the thickness of the cusps, *without destroying the occlusal angles,* the usual preparation of the occlusal end

Fig. 270.

Fig. 271.

for the backing should be observed. As the cusps to be subsequently attached will afford the necessary reinforcement, a single backing of 34 gauge, pure gold, is all that is required, and this should be closely adapted to the facing, trimmed to the *cervical shoulder,* as indicated in anterior dummies, and even with the approximal edges. A slight surplus, however, should remain upon the occlusal edge (Fig. 269), as a means of aiding in the adjustment of the cusps, and of insuring the penetration of the solder between them and the backing, thus making a close, flush joint.

Occlusion. While the cusps may be formed with any of the various die-plate systems, the best results are usually to be obtained by making special cusps to fit both

the facing and the occlusion, as described in connection with the telescope crown, and for the same reasons.

Carved Cusps. When the cusps are to be constructed in this manner, the backings should be retained to the facings by simply bending one of the pins down upon it, allowing the other pin to remain out straight, or slightly crooked. The facings should now be adjusted to position on the model, and temporarily retained thereon from the buccal side, with wax. (Fig. 270.)

Ordinary means of preventing the plaster from adhering to the model should now be observed, and thin well mixed plaster then poured in against the backings, and the articulator firmly closed. After hardening, the plaster cusps thus formed, which are retained to the facings because of the position of the remaining pin, should then be trimmed and carved as previously described. (Fig. 271.)

Fig. 272.

Fig. 273.

In the carving, any interlocking of the cusps with the opposing teeth should be avoided, and when this part of the procedure has been accomplished in a satisfactory manner, the plaster cusps, with their respective facings, may be separated from each other with a *very thin* ribbon separating file, or mechanical saw, after which the cusp-button, or die, if preferable, and counter die for each one should be made, and the cusps swaged.

In fitting the gold cusps to the facing, when the plaster cusps have been detached, care should be exercised to avoid a buccal edge of gold which would be necessarily conspicuous, hence this portion of the cusps should be cut away until when approximated with the backing, only a single thickness of gold remains (Fig. 272), and this should, of course, at the time properly occlude with the opposing teeth.

When thus fitted and all overhanging edges or any possible impingement is avoided, the relation should be sustained with wax, and each dummy then separately invested and soldered.

Attaching Facing and Cusps. In the attachment of facing and cusps with solder, it is desirable that each dummy should be completed as nearly as possible; at the same time, and hence, for hygienic reasons, the form of the lingual surface of each should be made of a more or less *convex* shape, in

order to avoid the formation of an inaccessible pocket between the cusps and the gum, when the bridge is finally mounted. (Fig. 273.)

This proper form may be obtained by carefully shaping and fitting a plate of 22 k. gold about 30 guage to the desired outline, after investing, and before heating the case, and then when the cusps have been sufficiently reinforced with solder, placing this form in position and simply

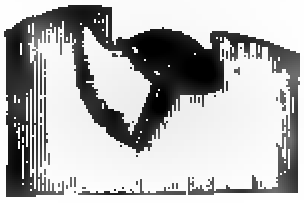


Fig. 274.

attaching it to the edges of backing and cusps with solder. (Fig. 274.) Such a type of construction offers the advantages of economy of material, and weight, of the finished piece, and is particularly applicable to large, long facings.

A similar shape may also be obtained by the use of solder alone; or scrap gold and solder, or by the more economical means of partially filling the space with german-silver forms made for the purpose (Fig. 275), or with small globules of pure copper or silver, any of which may be used with 18K. solder. The latter procedures are permissible providing such

Fig. 275.

forms or globules are not melted in the fusion of the solder, thus becoming alloyed with it, and also provided that they are then adequately covered with the solder so as to completely bury them, and preclude the decidedly metallic taste which would be very apparent and objectionable if at all superficially exposed to the action of the secretions.

The early practice of grinding the occlusal ends of the facings flat and blunt, allowing the cusps to remain of uniform depth, filling them flush with solder, and then placing the facings square on top of the gold, without any intervening backing, is not productive of the artistic results

now usually demanded. Facings and cusps made by old as compared with the more modern method when the angles of the facing are preserved, are shown in Fig. 276.

Continuous Cusps. The making of cusp-forms for two or even more facings at one time, and in one continuous piece, is sometimes practiced, but is not as reliable a procedure as the former method of making them separately, for the reason that the difficulty of accurately fitting such forms to the ends of the facings and to the occlusion, at the same time, is proportionately increased, as is also the danger of fracturing the facings in attaching them to the

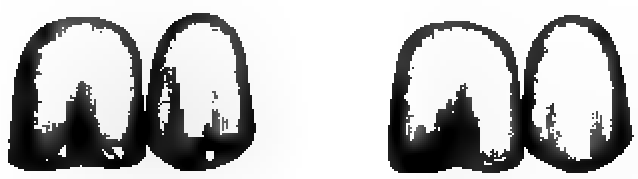
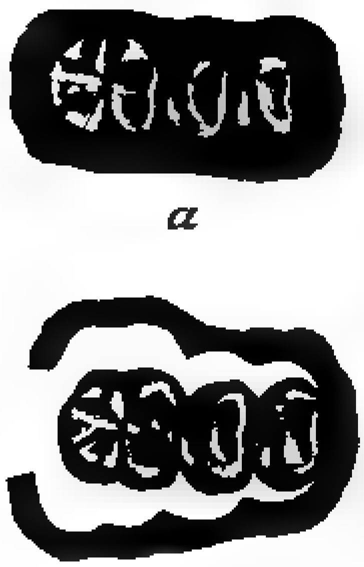


Fig. 276



a

b

c

Fig. 277.

cusps. Hence the former type of construction is the safest, and, in general practice, the most expedient method. Except in very small cases, or in rare instances, such time-saving procedures should not be resorted to, and are not productive of the very best results.

Carved Cusps. If it seems desirable or expedient to employ such methods, however, the procedure is equally applicable to carving the cusps, or using die-plate cusps, as may be preferred.

In the former instance, the cusps may be carved as usual, and the dies made at one time without separating the facings and cusps, after which the cusps may be swaged, trimmed, fitted and soldered, thus completing the dummies all in one piece, when they should be subsequently attached to the abutment pieces.

Die-plate Cusps. When it may seem desirable to make a continuous chain of cusp-forms by the die-plate method the Hollingsworth system perhaps offers the most favorable opportunities.

In the use of this method suitable cusp-buttons should be selected, placed in their proper relation on the steel-plate and the die and the counter-die made, after which the gold may be swaged (Fig. 277, A), the surplus trimmed away (Fig. 277, B), and the adjustment then made, as nearly accurate as possible, on the articulator (Fig. 277, C).

All-Gold Dummies. The requirements of occlusion, together with the limitations of space may, not infrequently, indicate the employment of all-gold dummies, in preference to those constructed in combination with porcelain facings, as a means of insuring the greatest possible degree of strength or of obtaining absolute indestructibility in the finished piece.

Indications. Even though the increased strength obtainable by this method is gained at the expense of the highest esthetic requirements, still in a certain limited class of cases where the occlusion upon the dummy, or dummies, is heavy; where the space is either abnormally large or constricted; where a single dummy is to be placed between two gold crowns, or where they may not be within the range of vision, or too flagrantly conspicuous, such dummies may be used to good advantage. This would practically confine their application, however, to the substitution of second molars in the upper arch, and of first and second molars in the lower arch, where the abovementioned requirements and conditions seem to demand an absolutely indestructible dummy.

Construction. When the abutment pieces have been completed and the case is mounted upon the articulator, at least two general methods of procedure may be followed in the construction of this style of dummy.

First, where a single dummy is desired the entire space between the crowns may be varnished, and then filled with soft plaster, and the articulator closed into proper occlusal relation, after which this plaster may be trimmed and carved to the correct occlusion, and to the desired buccal outline and cervical adaptation. (Fig. 278, A.)

The plaster dummy thus formed may be imbedded in mouldine and a die, and then a counter-die, of the buccal and occlusal surfaces secured. (Fig. 278, B.) Twenty-eight or 30 gauge 22K. gold should now be carefully swaged, trimmed and fitted to position on the models. The occlusal

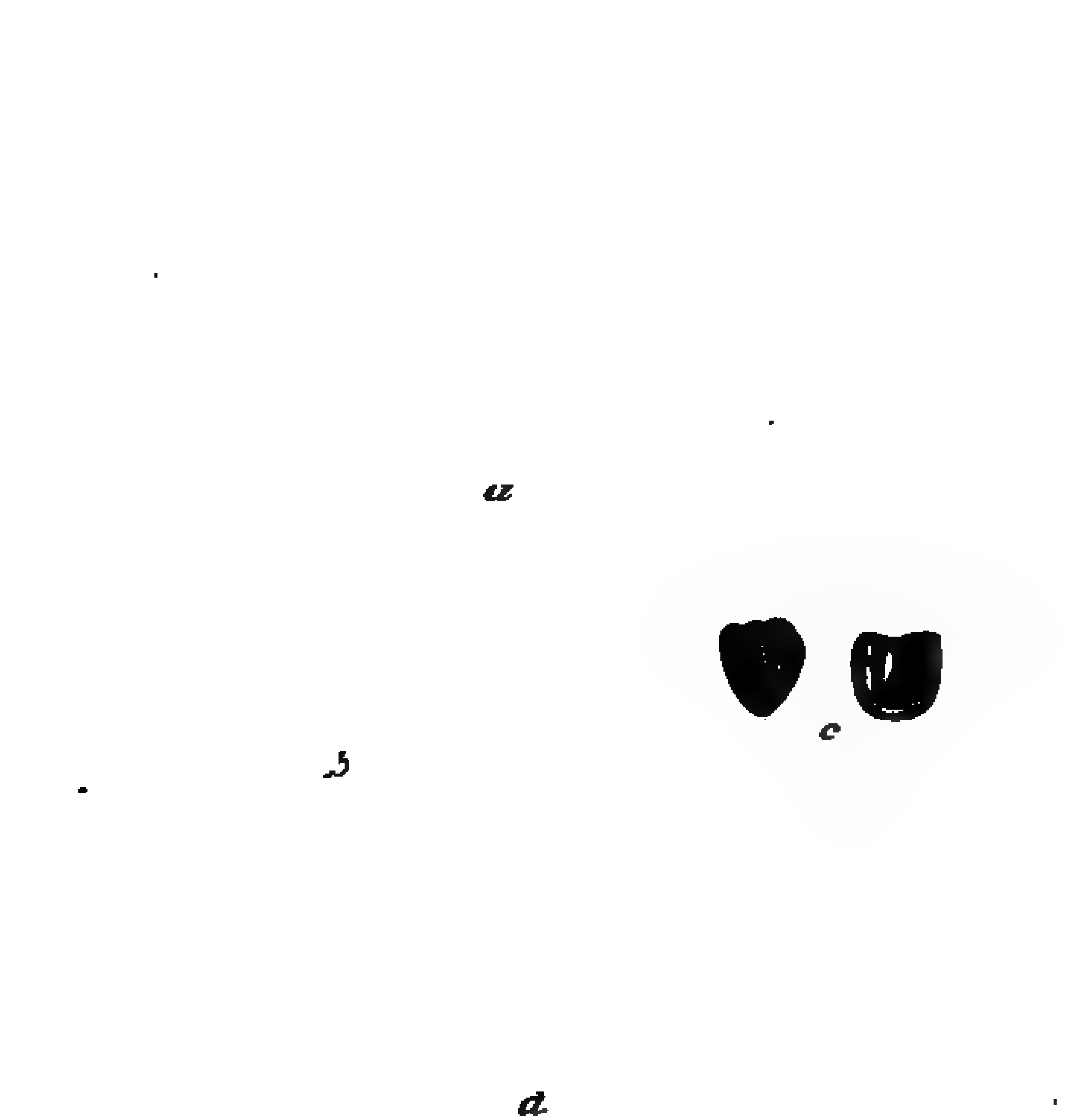


Fig. 278.

surface of the cusps may then be reinforced with solder, and the desired convexity of the lingual surface obtained by soldering a backing of the same gauge gold, to the edges, or by filling in, as previously described in connection with porcelain face dummies. (Fig. 278, C.) The typical application of such dummies to practical cases is shown in Fig. 278, D.

Second, the time thus consumed in carving a plaster dummy may be saved by using an ordinary porcelain tooth designed for vulcanite work, grinding it to properly fit the space and occlusion, and then reproducing it in gold of the above gauge and karat, by means of an imprint in mouldine and fusible metal dies, as just described.

Either method is productive of good results, and where two or even more dummies are to be used in the same case, this procedure should be followed for each dummy. While possible, of course, it is scarcely practicable to make them continuous, owing to the combined requirements of occlusion, buccal alignment, cervical adaptation and lingual contour, for all of these can be better observed with greater facility and accuracy by making them separately.

Fig. 279.

Occlusal Surface Dummies.

Dummies involving only the cusps, or occlusal surfaces, may also be found to be a particularly useful style of construction in cases where the requirements and conditions are similar to those just mentioned in connection with "all-gold" dummies, but where contact with the ridge is unnecessary, or is contraindicated for hygienic or other reasons.

Indications.

It has been previously emphasized that all dummies should be either in "absolute contact with the ridge," or that "no contact at all should exist," and hence this type of construction is particularly useful in that class of cases where the excessive absorption contraindicates the abnormal extension of the dummies until contact is afforded; where the restoration of the masticating surface is all that is required, and where the absence of porcelain facings will not be noticed.

Thus it is apparent that the employment of this style of construction is applicable chiefly in restoring the masticating surfaces of molars, first, where considerable absorption has taken place, and particularly in

the lower arch, where facings are unnecessary for cosmetic reasons, or where their absence would not be noticed; and second, where the necessarily more or less unhygienic condition produced by contact with the ridge would be entirely overcome, and the absolute requirements conserved in the most hygienic manner possible.

Construction. In the construction of such dummies suitable cusp-forms may be made by any of the methods previously advocated. After being swaged and fitted to the occlusion and to the space between the "attachments," they should first be placed on an asbestos or charcoal block and filled flush and even with solder, and the whole then invested and assembled.

Fig. 280.

As the immediate center of this type of bridge is obviously the weakest part of the structure, where more than one of such dummies are used in a single piece adequate strength must be obtained in the final assemblage, and this can usually be best accomplished by fitting a piece of round iridio-platinum wire of about 14 gauge from abutment to abutment, and then freely covering the same from one end to the other with solder. Fig. 279 illustrates the typical application of two forms of such construction.

Lateral Gravitation.

Because of the natural tendency of teeth to move toward an unoccupied area in the arch, it not infrequently happens that one immediately adjacent to a space caused by the absence of a single tooth, may so gravitate either forward or backward as to ultimately occupy a position more or less in the center of the space. (Fig. 280.)

In such conditions of lateral gravitation, or similar ones due to non-eruption, when it is desirable to supply the missing tooth, one of two methods of procedure is usually indicated. Either the malposed tooth

should be previously brought back to its normal position in the arch, or its crown mav be sacrificed and the root used to support two facings of sufficient proportions to fill the entire space.

Correction of Malposition.

If the age of the patient and other conditions seem to indicate the former procedure, and to contra-indicate the destruction of the natural crown, the method of attachment to the malposed tooth should

Fig. 281.

Fig. 282.

first be determined, and the "attachment" made and adapted to the point of finishing. This can be done best before any effort to move the tooth has been made, for the reason that more ample space exists, and that the subsequent soreness during the fitting is thus avoided.

If suitable contact of the "dummy" with the natural crown of the adjacent tooth is provided, the fixture will also serve the purpose of holding the tooth in its new position, and no other form of retaining apparatus will be required.

"Attachment" and "Dummy" Combined.

Wherever the age of the patient, or the surrounding physiological conditions may seem to contraindicate regulation of the malposed tooth, it may be deemed practicable to sacrifice the natural crown and suspend two facings, which will completely fill the space, from the one supporting root. (Fig. 281.)

When this procedure seems indicated, any provision against rotation, such as has been previously recommended, is usually unnecessary, for the reason that the fulcrum here is in the center, and hence the stress to which either end may be subjected is materially diminished.

Fig. 283.

While gold may be used in combination with porcelain facings in such instances, the most artistic results are to be obtained from a platinum construction and porcelain work, because the cap between the necks of the facings, which will be conspicuous if of gold, may thus be hidden by the employment of *gum enamel* body at this point.

A striking evidence of the possibilities of lateral gravitation, when augmented by poorly adapted bridges and an unfavorable occlusion, is illustrated in Fig. 282. It will be observed that the wearing of a bridge supported only by the two right bicuspids and the left cuspid, and supplying the missing anterior teeth (previously illustrated in Fig. 231, A) without proper regard for the occlusion, has resulted in forcing these teeth forward until they are the full space of one tooth anterior to their proper position.

In the reconstructed case it will be noted, however, that the artificial substitutes represent the proper teeth irrespective of the fact that the

cuspid on the left side supports a lateral facing, and the first bicuspid on the right side supports a cuspid facing. (Fig. 283.) This feature is highly essential, and should always be observed in similar conditions

Opening of the "Bite."

A condition quite analogous to that accruing from the absence of adjacent teeth, and one often even more difficult to overcome in the application of fixed bridges, is that which almost invariably results from the absence of occluding members in the opposing jaw.

Fig. 284.

Elongation.

Indeed, whenever the teeth of either jaw are deprived of their normal occluding relations for any considerable length of time *elongation* is the natural sequel, and such conditions are often encountered, and, in proportion as the number of missing teeth increases, are frequently so aggravated as to demand the opening of the "bite" to an extent sufficient to admit of accommodation for the substitutes which are required to fill the spaces and restore the occlusion.

Whenever such conditions are encountered good models should first be obtained and accurately mounted upon the articulator. By this means it may then be definitely determined by a careful study just how much the "bite" should be opened, and which tooth, or teeth, may best be used as a means of *establishing* the desired, or *new* relation between the jaws.

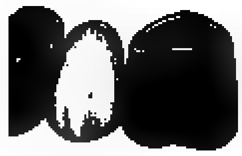


Fig. 283.

Fig. 28[illegible].

When this fact has been determined separate crowns constructed so as to meet such requirements should be made, and temporarily mounted with gutta-percha. After the occlusion is thus established by one or more crowns, the construction of the remaining work, which will supply the missing teeth and permanently sustain the occlusion thus fixed, should fol-

Fig. 287.

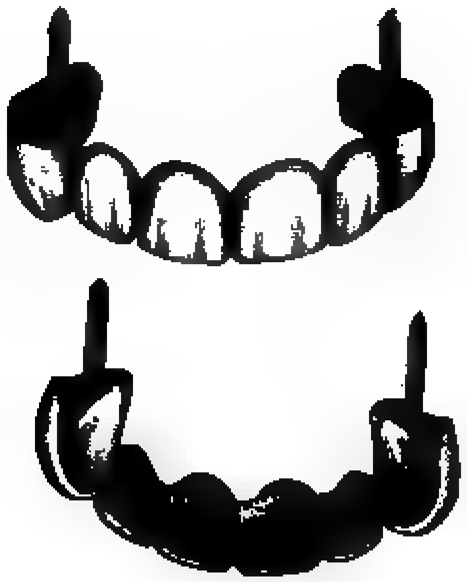


Fig. 288.

low; but in such conditions all of the posterior teeth on each side must occlude when the operation is completed, for otherwise the work of mastication would be thrown upon only a few teeth, and this would result in subsequent trouble. For this reason the new relation must not be permanently established by the final mounting of the work until all teeth involved are completed.

Fig. 289.

Fig. 290.

A typical case is illustrated in Fig. 284, where practically no occlusion has existed for a great many years, but where by cutting down the elongated teeth, and opening the "bite" by the construction of the lower bridge on the right side, first, a more or less perfect occlusion of all the posterior teeth was made possible.

Fig. 291.

Fig. 292.

Abrasion. Similar conditions often present as a result of the loss of some of the occluding teeth, complicated with that distressful waste, or "melting away," of tooth structure known as abrasion. In these cases an opening of the "bite" is frequently indicated as a means of arresting the progress of this combined mechanical and chemical influence, and of preserving the natural crowns of the remaining teeth, by throwing the actual work of mastication upon the artificial teeth exclusively. In this class of cases, however, the opening of the bite must be accomplished in such manner as to involve as much as possible all of the masticating teeth and thus avoid throwing the work on only a few.

Typical Application.

Whilst it would be quite impossible, and is indeed equally unnecessary, to attempt to illustrate all variations of bridge construction for "fixed" appliances where *full crowns* are used as the attachments, which would be more or less practical; and while the fundamental underlying "principles" have already been discussed in their proper place, still for the benefit of the inexperienced operator it is deemed expedient to illustrate some of the more typical applications which are embraced in the preceding types of construction.

Fig. 293.

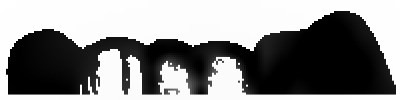


Fig. 294.

For this reason the accompanying illustrations are presented with a view to covering a range extending from the most simple to the most extensive structures, and it will be observed that the application of each respective type is practicable in accordance with the requirements, as previously indicated, except, of course, that in the more extensive cases, such as is illustrated in Fig. 292, the use of the cuspid instead of the central incisor roots would be a far more practicable procedure.

Diversified Principles.

CHAPTER XXII.

Interrupted Bridges: Indications, Application. Saddle Bridges: Indications; Excessive Absorption, Extension Bridges, Unfavorable Occlusion, Porcelain Bridgework, From a Hygienic Viewpoint, Contraindications, Requirements, Application. Extension Bridges: Indications.

The preceding methods of construction while designated as the typical and orthodox procedures, do not entirely constitute the sum total of those which occupy a permanent sphere of usefulness in the construction of fixed bridgework.

While it would be useless to attempt specifically to describe the myriad of methods which have been devised from time to time, and while many of them—still recommended in text-books—have already proven to be impracticable, and some have even become obsolete, yet others possess such merit as to warrant the classification and consideration which follows.

Interrupted Bridges.

Among the most prominent types belonging to the classification of "diversified principles" is the one wherein the presence, at some point in the arch, of a natural tooth which is not needed nor used as an abutment, may cause an interruption in the otherwise continuous relation of the various parts comprising the piece, and the particular type of construction thus resulting is designated an "interrupted" bridge.

Indications.

Whilst as a general rule it is always better and safer to employ a *maximum* instead of a minimum number of abutments, still there is nevertheless a limited class where the utilization of certain remaining good sound teeth is unwise or unnecessary, and therefore contraindicated, because of the opportunity for otherwise obtaining adequate strength in the

attachment of the piece. It is true that such cases are the exception rather than the rule; yet when they do present it would be manifestly unwise to involve a good tooth which is not actually needed in the support of the bridge. Such breaks in the continuity of the structure, however, should rarely if ever exceed the space of a single tooth, and this should be principally in the *upper* denture, and anterior to the first molar.

Application.

In the application of such a type of construction it is vitally necessary to observe that the connection between the parts on each side of the remaining tooth be made in such manner as to insure, first: adequate strength in the completed structure, and second: a relation between the connecting bar, the tooth, and the gum which will afford opportunity for cleanliness

Fig. 295.

admit of the normal occlusion, and offer as little obstruction to the movements of the tongue as possible. To obtain the latter features the bar should rest lightly upon the gum but should *not* come in contact with the natural tooth.

This connecting bar should be made of round iridio-platinum wire, 14 to 16 g, and should be cut the proper length, the ends then flattened on the anvil, and the desired adjustment made to the model just prior to investing the case. (Fig. 295.) The application of the principle to two typical cases is illustrated in Fig. 296.

Saddle Bridges.

As previously indicated under the caption of "classification" the term "saddle bridges" is applied to that type wherein the body of the bridge which supports the "dummies" intervening between, or adjacent to, the abutments, is conformed to the outline of, and placed in direct contact with the contiguous soft tissue.

The practicability of this method has long been, and indeed perhaps still is a somewhat mooted question, but it may nevertheless be safely asserted that whilst the possible virtues of the principle involved will increase or diminish in proportion to the degree of accuracy obtained in the adaptation, the *utility when judiciously employed*, is unquestionable.

Fig. 2

Indications.

Preliminary to the general indications for the selection of this type let it be said with emphasis that they are first governed entirely by the ability of the operator to recognize and appreciate the requirements of *judicious* application, and then to skilfully execute those of *accurate* adaptation.

Excessive Absorption.

In cases of excessive absorption where gum restoration is demanded, as illustrated in two classes, for example, in Fig. 297, a "saddle" is as essential as is the proper selection and arrangement of the artificial substitutes themselves, for the reason that, in fixed bridgework, only by such means may the required restoration and its proper adaptation be effected.

Extension Bridges.

The use of the saddle is also indicated in extension bridges where one or more posterior teeth supplying masticating surfaces, or which are to be subjected to masticating stress, are carried anterior or posterior to the abutment or abutments. In such cases the abutments must, of course, necessarily possess sufficient strength *per se* to afford ample and permanent support to the dummies, and the occlusion should be such as to throw a preponderance of the stress imposed upon the roots sup-

..g. 297.

porting the work, but a proper rest upon the tissue will then enable the dummies to offer and sustain a degree of resistance sufficient to make them comfortable and serviceable. If such a condition is not obtained, and the work assumed by the dummies is thrown entirely upon the abutments, it is but natural to expect the destruction or displacement of the piece, or the ultimate loosening and loss of the roots.

Unfavorable Occlusion.

In those cases where the position of the opposing natural teeth, or the absence of some of them, necessarily throws the greater portion of the stress of mastication upon the dummies, and perhaps even precludes any occlusion of the abutments, a rest upon the tissue beneath the area of greatest stress is indicated. The relief thus afforded to the abutment roots, especially where the span is a long one, and the additional strength afforded to the piece at its weakest point will often admit of the practical and permanent application of a "fixed" bridge which would otherwise prove a failure. (Fig. 298.)

Also in conditions known as "close bite," the utilization of the saddle may be indicated as a means of obtaining strength in the completed structure.

Porcelain Bridgework.

The saddle is particularly indispensable in porcelain work, for the reason that the friable nature of this material demands that such portions of it as form masticating surfaces and which are to be subjected to masticating stress must be protected and supported. Since the strength of this material increases in proportion to its bulk, as much as is consistent must be used in reproducing contour, and the saddle affords the only adequate means of supporting the superstructure;

Fig. 290.

hence, from this viewpoint, it makes possible the more permanent success of this class of work.

The Saddle from a Hygienic Viewpoint.

Contrary to the generally accepted belief that a saddle is decidedly unhygienic, such a device is frequently indicated in order to obtain *a closer approach to hygienic results.*

For instance, in cases where the occlusal surfaces of the opposing teeth in occlusion are in close proximity to the tissue in the space to be bridged, a condition commonly called a "close bite," and where the dummies to be supplied must possess a masticating surface in order that such a bridge may be serviceable as well as ornamental, the use of a well adapted saddle will result in a far more hygienic condition than the *lingual shelf* formed by the attachment of cusps to the facings.

While in such cases the cusps should not be large bucco-lingually, and the lingual surface of each dummy should be properly contoured, if possible, the surface of a bridge brought into close contact with the

tissue will often prove far more hygienic than the absolutely inaccessible recesses resulting from the usual method of construction. In this connection the surface of a well adapted saddle, and the possibilities for gum reproduction and lingual contour afforded by it, will often render the work cleaner and more comfortable to the patient than the ordinary construction, which with even favorable opportunity is often neglected, even by well-advised and scrupulously cleanly patients.

The question very naturally arises as to just what condition the tissue under such circumstances may ultimately present, and what, if any, physiological change or pathological disturbance will occur.

Upon the removal of such bridges worn from three to five years, where the adaptation had been good, the surfaces of the saddles have been found clean and comparatively free from accumulations, except some little exfoliated epithelium; the patients had experienced no particularly unpleasant taste nor offensive odors, and the tissues, while presenting a slightly reddened, somewhat congested appearance, due perhaps to a superficial capillary stasis, as a result of the pressure, indicated no marked evidences of soreness, inflammation, hypertrophy nor resorption. Such results could only be expected, however, where a good, close adaptation without irritating influences existed.

Whatever merit and advantages a saddle may possess, and however useful it may sometimes prove, however, there are conditions contraindicating its use quite equal in importance to those demanding it, and these must be observed even more closely in order to preclude the evil results of an unnecessary, unwise, or injudicious application.

Contraindications.

In bridges extending anteriorly to the second bicuspid where no masticating surface is necessary, as has been said, it is often practical to carry one "dummy" without any support upon the tissues beneath it, but in such cases the abutment from which it is extended should, of course, possess sufficient strength, and should assume a preponderance of the stress imposed.

The saddle is also unnecessary, and consequently contraindicated, in those cases where the abutment roots are close enough together and sufficiently strong to withstand the stress assumed by the entire fixed structure; where the occlusion is favorable, and where every opportunity is afforded for the self-cleansing contour of the lingual surface.

The saddle is also contraindicated in all cases where thorough and complete absorption of the tissues has not taken place. If this is not observed the subsequent absorption will not only destroy the usefulness of the saddle, but will result in a decidedly unhygienic condition.

As the success of the saddle is so dependent upon a proper and sufficiently close adaptation, it is also, of course, always contraindicated whenever and wherever every facility is not offered for such relation.

Requirements. A consideration of the requirements must begin by repeating and specially emphasizing the assertion that the success and usefulness of a saddle will increase in proportion to the accuracy of its adaptation. It must fit the tissue perfectly and must rest upon it with *uniform pressure* at all points so as to afford some little relief to the abutments, and to preclude the infiltration of food-laden secretions between it and the tissue upon which it rests; yet, of course, not sufficiently hard to cause capillary stasis, or to induce reabsorption. In *size* it should be *no larger,* nor cover a greater area *than is absolutely essential* to the work to be assumed by the teeth it is intended to support, and the *edges* should be *rounded* and *smooth,* so as to exert no possible irritating influence. It should also be made of a metal which is least susceptible to the chemical action of the secretions. For this reason the use of *platinum* is universally indicated, because, this metal is least affected when subjected indefinitely to such action, and, in consequence, will more permanently retain its color and lustre, and remain cleaner, than gold of any degree of fineness.

Application. The importance of adaptation has already been mentioned, and while various methods have been employed as a means of obtaining this, it is often accomplished with difficulty. The following method, however, will overcome many obstacles and insure a degree of accuracy which will add much to the practicability, serviceability and cleanliness of the saddle. The "attachments" or "abutment pieces" should first be completed as usual and adjusted to position on the roots. An impression of them and the intermediate or adjacent tissue should then be taken with plaster. If the crowns are withdrawn in the impression they should be removed thereform and laid aside for the time. The open ends of the impression should then be filled in with moldine or plaster, and, if necessary, the whole may be built up or extended sufficiently to give adequate body and strength to the metal model, or die. After drying, the die should be secured with any fusible alloy, and this will, of course, present a perfect reproduction of the abutment pieces in position, and their relation to the tissue upon which the saddle is to rest. This die should then be built up, as above suggested, in order to form a matrix for the counter-die, in which it is only necessary to leave the surface of the crowns, or attachments, presenting toward each other, and the *ridge,* exposed. After coating the exposed

surfaces with a thin solution of whiting, which will be found to be the best and cleanest separating medium, the counter-die may then be easily obtained with the same alloy. Die and counter-die are shown in Fig. 299.

Thirty-two gauge platinum, or, iridio-platinum if stiffness is desired, should then be swaged and trimmed to the required form. Twenty-two karat gold of the same thickness may be used in an emergency, but the former is preferable.

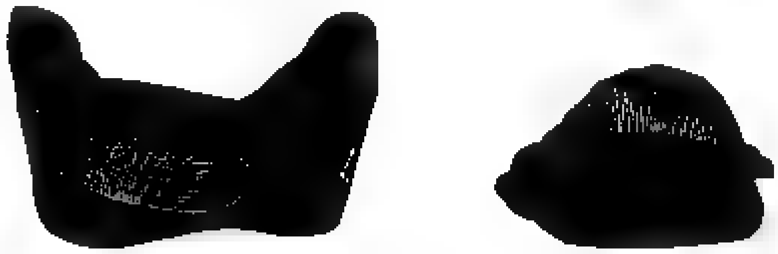


Fig. 299.

The shape and conformation of the tissue upon which the saddle is to rest, and the size of the dummies to be supported, should guide in the shape and form given to it. In broad, flat ridges the saddle may be proportionately larger, of course, than in thin, sharp, narrow ones, the usual width varying from three to five-sixteenths of an inch, except that in the latter class, in the lower jaw, the convex surface of a half-round wire of suitable size, placed in contact with the ridge, will often answer nicely. When the wider saddle seems indicated, however,

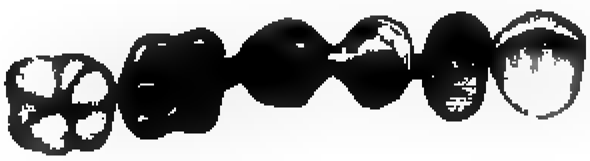


Fig. 300.

and particularly in the upper jaw, it is usually best to leave it full width immediately beneath the dummies only, by cutting it away to some extent in the interproximal spaces as originally suggested by Dr. W. H. Taggart. (Fig. 300.) Such a shape affords opportunities for sufficient support and lingual contour beneath the dummies, and especially in gold work, less conspicuous and cleaner interproximal spaces.

When properly swaged and trimmed the "attachments" or abutment pieces should be adjusted to position and the saddle finally adapted and

trimmed to the desired outline, in the mouth. Each end should be fitted so as to come in direct contact with the crowns or "attachments" when slight pressure is applied, and the edges should not be allowed to lap over upon them, as such a joint might destroy the accuracy of adaptation at this more or less vulnerable point.

It now becomes necessary to preserve an absolutely accurate relation between tissue, saddle and abutment pieces until the same is permanently

Fig. 301.

sustained by soldering. This can be accomplished by taking an impression of the parts in position, in plaster, with sufficient pressure upon the saddle to insure a slight bearing upon the tissue. This may be secured by the use of a prop of orangewood, of suitable length to keep the mouth open, with one end resting upon the center of the saddle and the other against the opposing teeth or ridge. (Fig. 301.) With this so adjusted, and a firm closure upon it, the saddle is gradually and gently forced against or into the tissue, when the impression can be taken without relieving the pressure. For this purpose may be used an ordinary impression tray with a slot cut into it from the heel sufficiently wide to accommodate or straddle the prop, so that when filled with plaster it may

be easily carried to place. (Fig. 302.) By such means a uniform pressure such as may scarcely be obtained in any other manner is sustained, and the closeness of the relation is proven by the fact that the plaster seldom penetrates beneath the saddle in taking the impression.

If this method is not adopted similar results may be obtained by tightly fitting a wedge of wood between the abutment pieces, and then closely packing a rather stiff wax, or temporary stopping, between the wedge and the saddle in such manner as to hold the latter firmly in place against the tissue. Care must be exercised, however, to leave at least the edges of the saddle so exposed as to obtain an imprint in the impression which will insure its proper replacement and retention therein after removing and before filling. (Fig. 303.)

When the impression has been secured it should be varnished and then filled with *investment material,* which, after separating, will admit of the permanent attachment of the parts with solder. The piece should then be replaced in the mouth and the edges of the saddle carefully

burnished to a close and accurate adaptation with a suitable and fairly heavy burnisher, when the "bite" and final impression for the completion of the work should be secured.

These orangewood props, or wedges, should be cut in various lengths to meet the requirements, and may be made applicable, where there are no opposing teeth, by covering the end which rests upon the tissue in such cases with a cushion of modelling compound or sealing wax. (Fig. 304.)

Fig. 303. *Fig. 304.*

In the mounting of fixed bridges where a saddle is used, several precautions must be observed. Those, together with other closely allied considerations, will be subsequently presented and fully discussed under the subject heading of "mounting."

Extension Bridges.

The type known as "Extension" bridges embodies the extension of one or more "dummies" anterior or posterior to the abutments, either with or without a "saddle" resting upon the contiguous soft tissue, and except in those cases previously mentioned where a *single tooth is suspended* from a single abutment, is without doubt one of the most pernicious practices incident to the application of "fixed" structures.

Whilst the principle involved in nearly all types of construction other than those mentioned is mechanically wrong and much injury to, and even the possible loss of the supporting teeth, may result, yet there are occasional instances where the application may be made more or less practicable.

Indications.

Such instances are necessarily confined to those cases where the conditions may be, or are, made favorable by the ratio between the stress received by the "dummies" so extended, and the inherent strength and stability of the abutments.

For instance, as has been previously stated, certain teeth in the arch are quite capable of supporting a single extended "dummy" under the

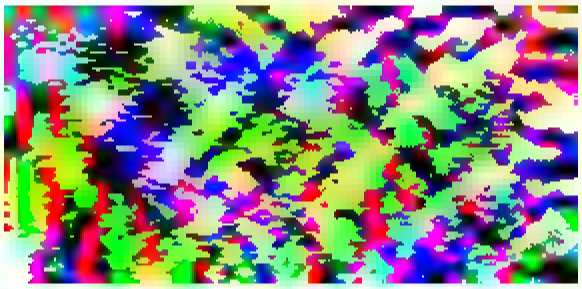


Fig. 305.

conditions mentioned in connection therewith (see *"principles"*), but no one tooth will support *more* than a single dummy in any conceivable manner, for any length of time.

Fig. 306.

The practice, therefore, of suspending even a small "dummy" on *each* side of a single abutment, which unfortunately is sometimes observed, (Fig. 305), is so remote from sound mechanical principles and even from reason and common sense, as to be vicious, and the see-saw, teter-board movement thus invited will invariably result in the very early loss of the supporting tooth.

Another practice not uncommon is the extension of single anterior dummies from posterior abutments with remaining natural teeth intervening, as shown in Fig. 306.

While some means of supporting substitutes for missing anterioı teeth without involving the mutilation of adjacent good sound teeth would be eminently desirable, it must nevertheless be remembered that in proportion as the point which receives the stress is removed from the fulcrum, or point of resistance, the stress becomes increased, and the resistance correspondingly diminished, and that under such influence, therefore, the displacement or loss of the supporting tooth becomes only a question of time.

Fiq. 307. *Fiq. 308.*

Granting that the abutment thus employed may be so supported by the roots of the adjacent teeth as to fortify it to a greater or less extent against displacement, and granting also that the extension bar may first be swaged of pure gold, and thus well and closely adapted to the tissue upon which it rests, and may then be stiffened and strengthened by clasp metal and solder, all of which is necessary, it nevertheless rests upon soft tissue, which, together with the elasticity of the metal would necessarily admit of some movement under stress, and as a result the extension bar would soon become imbedded in the soft tissue; the suspended "dummy" become too short; and the tissue beneath both so hyperaemic and inflamed, that the supporting tooth would prove unequal to the demands, and the fixture would become a failure.

It is therefore evident that such a type of construction should only be used in rare instances, as a last resort, or, for temporary purposes, if indeed at all.

Perhaps the most favorable situation for this particular type of construction, aside from those already mentioned as applied to single

adjacent teeth, would be in such cases as illustrated in Fig. 307, where two or possible three posterior teeth upon one or both sides may be extended from several anterior abutments.

In such cases if a supporting "saddle" were adapted in accordance with the requirements, and the occlusion then made hardest upon the anterior teeth; or, if the opposing teeth were artificial, or some of them absent, some hope may be indulged for the serviceability and permanency of the fixture, but this will then be in proportion as the stability of the supporting teeth, and the condition of the contiguous tissues may be favorable.

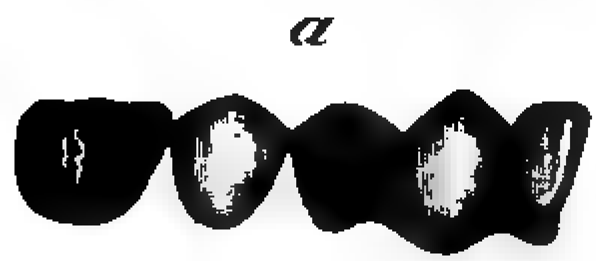


Fig. 309.

Also, another class of cases where such principles may be applied with some hope of reasonable utility and permanency is sometimes found where all of the molar teeth are missing in the lower arch, and where for cosmetic reasons as well as from a viewpoint of possible utility it may be desirable to supply one molar on each side.

In such instances if the occlusion and other environments are, or may be made, favorable, the *two* bicuspids may be used to support *one* suspended molar tooth, but in *no* instance *more than one,* and this should be supported by a well adapted saddle, and the occlusion so adjusted as to be harder upon the abutments than upon the dummy. Such cases have been known to serve successfully for a number of years. (Fig. 308.)

Another type of construction in which the first bicuspid is used to support a missing lateral, thus combining both the "interrupted" and "extension" principles—which is practicable under favorable conditions—is shown in Fig. 309A, and still another class of cases where the number, stability and position of the abutments may admit of extending even two dummies anterior to them with reasonable assurances of success and permanency, is illustrated in Fig. 309B.

In such instances it will be observed that but little actual work is required of the "dummies" thus extended, as compared with that assumed by the rest of the structure, and this accounts for the possible practicability of such application. Whenever it can be done it is usually best in the latter instance, however, to add to the support of the extended "dummies" by means of a well adapted saddle.

Detachable and Replaceable Teeth

CHAPTER XXIII.

Davis Crowns. Brewster Bridge Teeth. The Boos Method. Roach's Wedgelock Bridge Teeth. Steele's Crown and Bridge Tooth. The Louque Method. Bryan's Methods. Townsend's Method.

Among the diversified methods which are now in use, and which are regarded as being practicable when their application is indicated, are those wherein the various forms of *detachable* and *replaceable* teeth or facings are used.

Advantages. The principles involved in this class of work possess at least *three* important advantages. First, the cosmetic possibilities of the finished structure are enhanced by avoiding the display of gold incisal edges and occlusal surfaces. Second, the absence of any need for subjecting the porcelain teeth to the heat of soldering; and, third, the increased facility for effecting repair in the event of subsequent accident.

The first advantage is readily apparent because any method by which the conspicuous display of gold may be avoided has always been welcomed by the æsthetic and progressive prosthodontist, to whom the usual form of dummy made by the joining of porcelain facing and gold cusps has always been objectionable. Such operators have for years been awaiting the introduction of some form of porcelain tooth, more like the old "tube" tooth, particularly for bicuspids and molars, which would present an occlusal surface of porcelain instead of gold, and which would be of more or less universal application.

As applied to the second advantage, since so many who have never become skilled in soldering, proceed with timidity toward the assemblage of extensive pieces of which porcelain facings form a part, it is also obvious that any method by which this apparently intuitive dread may be eliminated will be equally appreciated.

Whilst there is absolutely no danger of, nor excuse for, fracturing porcelain facings in their final assemblage if the proper precautions, as previously described, are observed, still there *is* some danger of discoloration, and therefore there can be no possible objection to the previous assemblage of the metal parts only, and the subsequent attachment of the porcelain to them, provided that the retention of the latter may be secured in a manner which insures *at least* equal stability and permanency.

In this connection it is claimed by the advocates of this method of construction that if the base is properly adapted and sufficiently strengthened by reinforcement, the porcelain teeth or facings attached thereto with *cement* are far less liable to fracture under the stress of mastication than are those which are held so much more rigidly by solder. For the reason that the presence of a layer of *cement* between the metal and the porcelain must diminish the force of impact, and thus act as a slightly yielding medium, the claim seems logical.

The third advantage—that of the ease with which repair may be effected—is an equally important consideration. Any method which will facilitate and expedite the repair of dental bridges will materially lessen the burdens of the operator who attempts their construction, for accidents will happen, and to fixed appliances perhaps oftener than to any other form of prosthetic work.

In this connection, when this type is used it is well to keep a record of the number, mould and shade of each tooth used in each case, for the reason that in the event of accident to any tooth the replacement is thereby made comparatively easy by the facility with which the proper selection may be made, after which, grinding to fit and mounting with cement will constitute the requirements, and may be effected without delay.

Davis Crowns.

The Davis Crowns, which are well adapted to the construction of bridges of this type, offer a means of obtaining splendid results from the combined viewpoints of beauty, strength and hygienic properties.

Indications.

Their use is indicated in the construction of both anterior and posterior bridges, and for abutments as well as dummies, in that class of cases where the length of the crowns of the remaining natural teeth, and the amount of absorption where teeth are missing, will admit of their application without excessive grinding.

Contraindications. They would be contraindicated, however, in cases where but little absorption has taken place; where the crowns of the remaining natural teeth are very short, or where the "bite" is extremely close; and also in cases of excessive absorption where the neck of the crown could not be placed in contact with the ridge.

Application to Anterior Bridges. As applied to the construction of anterior bridges the roots should be prepared in the prescribed manner except that they should be cut even with, or slightly beneath, the gum at all points, and the caps made by the usual method, the band being very narrow and of 22K. gold, or platinum, 29 or 30 ga., and the floor from 30 to 32 ga. When the caps have been thus made and properly adjusted to the roots the canals

a *b*

Fig. 310.

should be prepared, the floors perforated, and the dowels fitted and then soldered. The apical end of the dowel made expressly for these crowns, or one of iridio-platinum, may be used; but all surplus should be trimmed away even with the floor after soldering.

Construction of Abutment Pieces. After thus completing the caps (Fig. 310 A) they should be placed in position on the roots and a bite in wax and impression in plaster taken. When the latter has been prepared for separating, the interior of the caps should be filled with a thin film of wax, to admit of easy removal from the model, and the model then obtained and mounted upon the articulator with the "bite."

Suitable crowns should now be selected and ground to the proper adaptation in so far as the required adjustment is concerned. After this it is necessary to grind away from the *base* enough to admit of sufficient thickness of gold to reinforce the cap and adequately support the crown, and then slightly hollow out the approximal surface presenting toward

the dummies so as to accommodate, and give finishing line for, an extension of the backing toward the contact point. (Fig. 310 B.) This affords a greater soldering surface and admits of filling in the space between the teeth in assembling, thus insuring a greater degree of strength and a much cleaner fixture when completed.

When the crowns are thus prepared, backings of 32 ga. 22 K. gold should be closely adapted to the base and approximal sides, which may be done best by swaging directly to the tooth itself. To accomplish this fill one of the rings of any cylinder and soft rubber plunger swaging device with softened *dental lac*, or modeling compound, and force the crown down in it as illustrated in Fig. 311 A. When this is hard, trim to expose the surfaces previously ground; adjust the dowel made for this type of

a

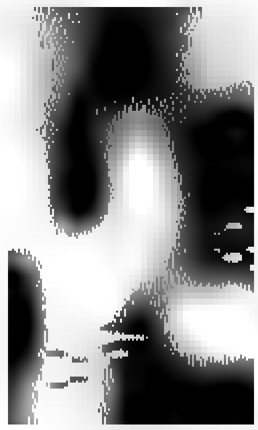


Fig. 311.

crown with the solder resting firmly in place in the crown; perforate the disc of gold and place it over the dowel (Fig. 311 B); adjust to cylinder, insert soft vulcanite plunger and swage (Fig. 311 C).

After swaging, trim away surplus gold to proper outline, burnish down close to crown, and then solder the dowel to the backing. The proper relation will be sustained by the fit of the backing to the shoulder of the dowel, but in uniting them only a small quantity of solder should be used, and care must be exercised to prevent it from flowing beyond the shoulder on that side of the backing which is adapted to the crown. This may be avoided by previously coating the surface mentioned with a thin solution of whiting.

The surplus *apical* end of this dowel, which is now not needed, should be cut down close to the surface of the backing, and the latter then placed in position on the crown, and both adjusted to proper relation with the cap on the model.

This relation between the backing and the cap should now be sustained with hard wax, and the whole then gently removed from the model, and the joint between the two well filled with wax. The crown may now be carefully detached and the cap and backing invested, and this subsequently trimmed in such manner as to expose the entire joint (Fig. 312). If the interior of both pieces are well filled with investment material, and the investment is then trimmed as indicated, no difficulty will

Fig. 312.

be experienced in completely filling the joint with at least 20 k. solder, thus completing the construction of the abutment pieces (Fig. 313). If the cap is made altogether of platinum as a means of precluding the possibility of fusing it in soldering, the band may be entirely covered with solder in uniting the pieces, if care is exercised to have it freely exposed, clean, and properly fluxed.

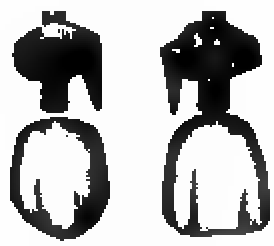


Fig. 313.

Construction of Dummies.

When the abutment pieces are thus finished they, with the crowns in place, should be adjusted to the model and the dummies then prepared. Except that the base of the crown should be ground to fit the model as closely as possible, and that both approximal sides should be hollowed out, the details incident to obtaining the adaptation of the back-

ing, and the adjustment of the lower portion of the dowel to it, for dummies, are identical with the procedure described for the abutment pieces.

Assembling. To facilitate the final assemblage on the model, cover it between the abutment crowns with tin foil and then sustain the relation of the parts with hard wax, after which the porcelain crowns may be removed and the metal parts then easily detached from the model and invested as shown in

Fig. 314.

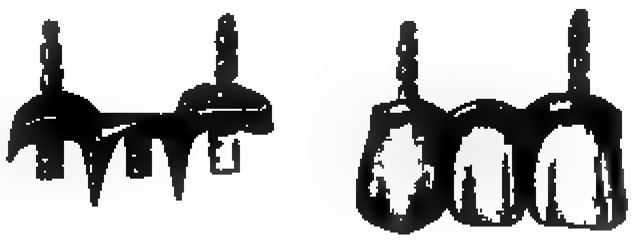


Fig. 315.

Fig. 314. In soldering, care should be exercised to completely fill the joints between the parts, and to so reinforce the base which supports the dummies as to insure strength. When the soldering has been completed the case should be first properly finished and polished, and the crowns then mounted with cement (Fig. 315).

Application to Posterior Bridges. In a somewhat modified and much more simplified form the same principles are applicable to the construction of bridges involving the posterior teeth in which application the process is known as the Davis-Townsend method.

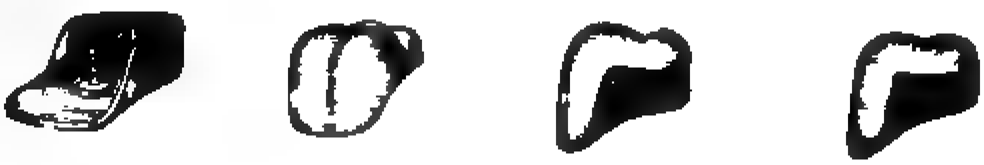


Fig. 316.

Davis-Townsend Method. This method differs from the former only in that *caps* or *boxes* of gold about 30 ga., which accurately fit the base of the bicuspid and molar crowns are provided by the manufacturer, or may be made (Fig. 316), and that they are designed to be used, mainly, as dummies, in conjunction with any type of crown or abutment piece.

In the construction of bridges by this method the abutment pieces should be completed first, and the bite and impression taken with them in position. When the model has been obtained and mounted on the articulator these gold caps should first be selected, and afterward the crowns which will fit into them.

The caps and crowns *together* should then be ground to the required and proper adaptation to each other, to the model and to the occlusion, after which the gold should be carefully burnished around the edges of each separate crown. They should then be properly assembled on the models and the relation of the gold caps securely sustained with hard wax. The crowns should then be removed and the spaces between the caps filled with wax, when the piece may be carefully detached, invested

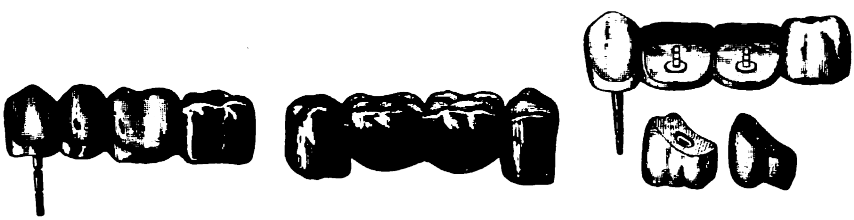


Fig. 317.

and soldered, following the same detail recommended in the preceding method.

In favorable cases where a good selection of these crowns may be made, the procedure is simple and expeditious, and the results gratifying (Fig. 317).

Brewster's Bridge Teeth.

Another type of porcelain tooth designed especially for bicuspid and molar dummies, and to be used in the manner indicated in the preceding method, is manufactured by the Brewster Dental Co., of Chicago. The principle involved in this tooth differs from the original "tube" tooth, Davis Crown, and similar types, in that the lingual surface is not so deep *cervico-occlusally*, thus giving it a greater range of adaptability to the varied conditions of absorption and occlusion, and in that the dowel enters the porcelain at such an angle as to admit of considerable grinding and yet always offer a maximum degree of strength.

Indications.

Because of the opportunities for obtaining the combined requirements of strength and cosmetic effect, the use of these teeth is more or less generally indicated whenever the above conditions are at all favorable to porcelain, in bridges involving the posterior teeth where gold is to be used in the construction of the abutment pieces and in the assemblage, and yet where it is desirable to avoid its display.

Indeed, it would seem that this or a similar type of tooth would eventually largely supersede the porcelain facing and gold cusps as substitutes for those teeth within the range of vision, and that their usefulness and more general application will increase in proportion as the variety of moulds and colors are extended.

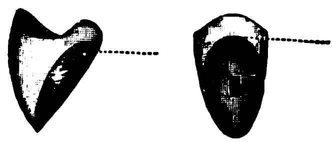
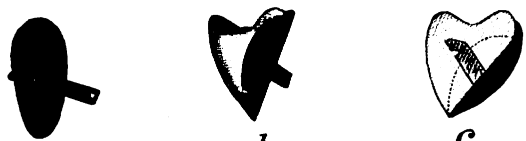


Fig. 318.



a *b* *c*

Fig. 319.

Application.

In the application of these teeth the abutment pieces should first be *completed* and a model with them in place thereon obtained and mounted on the articulator. The teeth should then be selected and ground to the proper adaptation to the requirements of contact with the model, and of occlusion, being careful, however, to also allow a slight space to exist between each tooth, and between them and the abutment pieces. This precaution is necessary as a means of providing for the shrinkage of the solder in assembling the backings, and of thus admitting of the replacement of the facings after the parts have been united.

Backings of pure gold from 30 to 32 ga. should then be closely adapted to the entire lingual surface of each tooth, which may be done by swaging, as previously described or by burnishing, if preferable, and to better protect the cusps should be allowed to slightly overlap upon the *lingual* surface at this point (Fig. 318).

When the backings are thus properly adapted, they should be perforated to accommodate the dowel. This can be done to the best advantage with a punch the same size and shape as the dowel, or with a small round bur, but in either instance care should be exercised to avoid turning an edge of the perforation down into the socket in the tooth, as that precludes the ready separation of the dowel and backing from the tooth.

A piece of the iridio-platinum dowel with serrated sides, which is made expressly for these teeth and which accurately fits the socket (Fig. 319 A), should then be grasped firmly with pliers and gently forced through the backing and into the full depth of the socket (Fig. 319 B). This relation should now be securely sustained with hard wax until the dowel and backing together may be removed from the tooth, invested

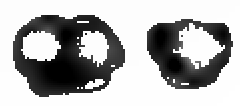


Fig. 320.

and soldered. The detachment of the porcelain tooth from its backing may be facilitated by sealing the end of a short stick of hard or sealing wax to the cusps of the tooth just previous to separating them.

As strength in the metal superstructure is a very important feature in the use of these teeth, the backing should be well reinforced at this time, and particularly around its linguo-occlusal edge as a means of *boxing* up the lingual cusps, and of thus insuring adequate support to them (Fig. 319 C), and this should be done with a liberal use of 22 or 20 K. solder, so that it may not be re-fused in the final assemblage.

When this has been accomplished the backings should be cleaned in the acid bath, adjusted to position on the teeth, and both then properly assembled on the model. After securely uniting the metal parts with hard wax, the teeth should be carefully removed therefrom and the backings and abutment pieces then invested. If investment material *sufficient to*

securely hold the parts together be used ***at this time,*** and the model subsequently trimmed away until the under surface of backings is freely exposed, no further investment will be required.

As a means of insuring a maximum degree of strength in the final assemblage of the various parts a piece of round iridio-platinum wire from 14 to 16 ga. should be fitted over the center of the backings from one end to the other, after which the case may be heated, and the soldering completed with 18 K. solder, when it should be finished and polished and the teeth then mounted with cement.

Variations.

Teeth which are slight variations of the same principle are also manufactured and may be used for anterior teeth, on "saddle" bridges where the bite is exceedingly or moderately close, in either "fixed" or removable structures, and as posterior teeth for the lower arch where only the occlusal surface is desired in order that "open" or "self-cleansing" spaces between them and the gum may obtain (Fig. 320). Typical cases showing the application of these teeth to bicuspid and molar dummies are illustrated in Fig. 321.

Fig. 321.

The Boos Method.

While several methods of applying the removable or replaceable principles to the ordinary long-pin flat back teeth, or even to vulcanite teeth, have been devised, the one known as the Boos method manufac-

tured by the Iowa Dental Specialty Co. is undoubtedly the most simple, complete and practicable yet presented. In a way this system is somewhat similar to that advocated by Dr. Emory A. Bryant, of Washington, which has been previously described in its application to crown work, but it is a decided improvement thereon because in the employment of Dr. Bryant's method the pins are allowed to remain at right angles to the long axis of the facing, thereby causing considerable bulk or thickness of backing immediately over them.

Thus when applied to the six anterior teeth—where both of these methods are most generally indicated—an unnecessary thickness would so often interfere with the occlusion as to materially limit the class of cases in which the method would be applicable.

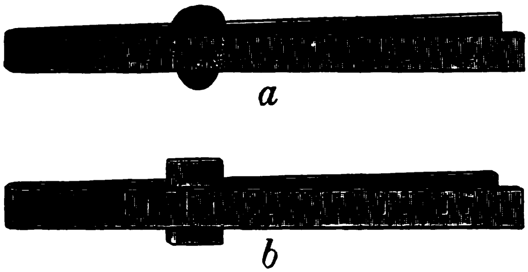


Fig. 322.

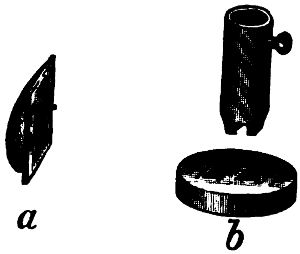


Fig. 323.

In the Boos method, however, this objectionable feature has been eliminated and even a more secure attachment of the facing is obtained, and therefore when confined to the six anterior teeth the range of application is more extensive.

Another highly important advantage is that the backing is *made to fit* the tooth. For this reason the method is applicable to any form, size or make of tooth, which, as compared with the necessarily more or less limited selection of facings offered by the manufacturers of other special forms of removable teeth is much in its favor.

Indications.

It is therefore apparent that this method is more or less generally indicated whenever it may seem desirable to employ removable or replaceable teeth, for abutment pieces as well as dummies, in the construction of anterior bridges; but the necessity for using gold cusps when applying the method to bridges involving the posterior teeth practically limits it to the six or possibly eight anterior teeth.

Application.

In the application of this method all of the facings for both crowns and dummies should be selected and ground to the required adaptation. The pins

of each tooth should then be adjusted to the proper holes of correspond ing distance in the "punch-plate" which accompanies the system (Fig. 322 a). After ascertaining which set of holes accommodates the pins the facing should be removed and a backing of about 32 ga., pure gold or platinum, cut somewhat larger than the tooth, then placed between the blades of the punch-plate (Fig. 322 b) and *slots* punched in it by means of the *"press"* which is also a part of the system.

When so prepared, the backing is then removed and placed in position on the facing, with the pins resting on one or the other edge of the

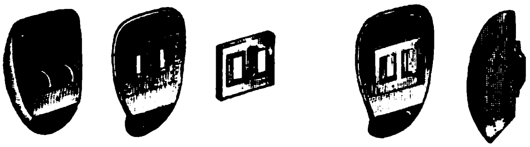


Fig. 324.

slots in accordance with the direction in which they are to be bent. If this is rootwise, which is usually the preferable direction in order that the incisal end of the backing may be as thin as possible, they should rest against the cervical edge of the slots (Fig. 323 a).

With the backing held in this relation it should be burnished or swaged with any of the swaging devices to a perfect adaptation, and

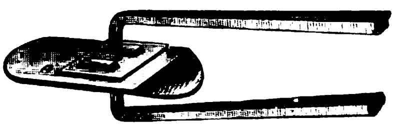


Fig. 325.

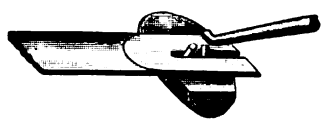


Fig. 326.

then trimmed to the outline of the facing. The next step is to construct a cover piece which will form a box for the reception of the pins and protect the slots from solder. This is formed by swaging between dies which correspond with the distance between the slots, the proper ones being selected from a set of three which are also a part of the system (Fig. 323 B).

This should then be properly adjusted to position on the lingual side of the backing, but as the raised places are purposely made longer than the slots, in order to accommodate the ends of the pins when bent, the cover piece must be so placed in its relation to the backing as to have

the extra space present toward the direction in which the pins are to be bent. Thus if the pins are bent rootwise the extra space must be in this direction (Fig. 324), while if to be bent toward the incisal end the reverse relation is required.

When the two are so adjusted they should be held securely in place with small pointed pliers, the immediate ends of which are bent at right angles (Fig. 325) and soldered with a small piece of 22 K. solder.

The pins should now be bent until their ends will engage in the space between the combined box and backing thus formed, which may be easily accomplished by placing the facing in the "tooth holder" and then using a suitable instrument (Fig. 326). If the pins are too long to enter after being bent, their ends may be cut off until the facing slips easily to place.

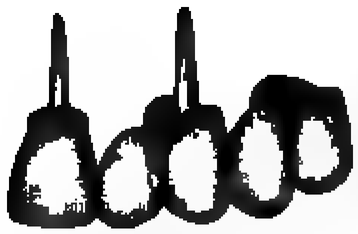


Fig. 327.

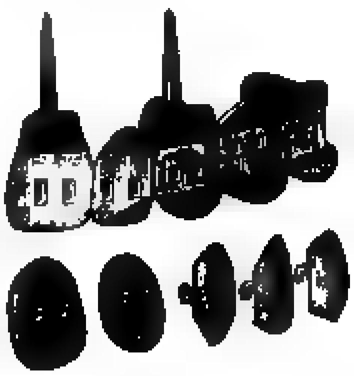


Fig. 328.

Facings and backings should now be adjusted to position on the model and the relation between the backings securely sustained with hard wax, after which the facings should be carefully removed and the aperture for the accommodation of the pins *filled with moistened whiting* as a means of precluding the possibility of subsequently filling this with solder.

The case should now be invested and soldered, and then finished, after which the facings may be attached with cement and the piece mounted. A typical case, including even the bicuspids, to which the principle is also applicable, is illustrated in Fig. 327.

Roach's "Wedgelock" Bridge Teeth.

The type of removable or replaceable tooth devised by Dr. F. E. Roach, of Chicago, and known as the "Wedglock," is another of the several forms designed to be used in this manner, but in this tooth a specially prepared backing forms part of the method.

Indications. The necessity for using them in conjunction with gold cusps when applied to the posterior teeth, however, practically limits the application to the six, or possibly eight, anterior teeth; but when confined in this range and when the conditions are favorable they offer opportunities for obtaining eminently satisfactory results, perhaps not exceeded by any similar form.

Application. In the application of these teeth to bridgework requirements are identically the same as in the construction of single crowns, which have been previously described in connection therewith, supplemented, of course, with those incident to the use of any of the various forms of detachable teeth. A typical case is illustrated in Fig. 328.

a Fig. 329. b Fig. 330.

Steele's Crown and Bridge Tooth.

The principle involved in the type of removable or replaceable tooth known as "Steele's" interchangeable crown and bridge tooth is similar to the one formerly called the "Mason" facing, which has also been previously described in connection with its application to crown work.

This form of tooth, however, differs from the "Mason" in that a dovetailed slot in the lingual surface of the porcelain tooth (Fig. 329 A) takes the place of the platinum "rib" of similar shape, which was formerly used, thus eliminating an element of weakness which was present in the original design, and also in that a projection which accurately engages into this slot in the porcelain forms part of the backings, which are, like the immediately preceding type, especially prepared for this tooth (Fig. 329 B).

If the presence of so large a slot in the immediate center of the porcelain does not also prove to be too great an element of weakness by increasing the liability of a longitudinal fracture, the application of this form of tooth will doubtless be productive of satisfactory results.

Application. Like the "Roach," "Dwight," or any other style of tooth having specially prepared backings, it is imperative that the surface of the backing which comes in contact with the facing should be kept clean and free from solder during its adaptation, and during the subsequent assemblage of the parts. Aside from this, all of the other requirements and precautions incident to the application of these teeth in a general way—which have already been mentioned—must also be carefully observed. Fig. 330 illustrates a typical case.

Variations.

The mechanical versatility of the dental profession is so frequently evidenced by the introduction of methods and ideas pertaining to the construction of dental bridgework that it is a difficult matter to keep pace with and do justice to all of the various systems presented. And yet, while those considered as being the most useful and applicable have probably been properly classified in the preceding pages, many good ideas may nevertheless be elucidated in the presentation of those deemed to be perhaps less practicable. Indeed, in learning where, how, or when *not* to use some methods, we may profit by the possession of knowledge from even the most useless ones. Although no effort will be made to consider the full range of methods, or those which are deemed absolutely useless, still the ingenuity manifested in some warrants their consideration here.

The Louque Method.

A method departing from the removable type of construction, and involving the employment of a special form of tooth designed

Fig. 331.

for and applicable only to bicuspid and molar dummies, to be used in conjunction with any of the various types of abutment pieces, and assembled by soldering, is known as the Louque method.

The form of tooth embraced therein differs from others in that it presents an all porcelain crown having a slightly concaved cervical end to facilitate its adaptation to the gum, or to a saddle, and in that it is

provided with a perforation extending laterally through its thickest part from one *approximal* surface to the other. This affords the means of attachment or assemblage, and is obtained by backing the tooth around a thin platinum tube which remains as a part thereof (Fig. 331).

Application. In the application of this method the teeth are assembled by means of passing a piece of iridio-platinum wire through the platinum-lined perforation, allowing its end to project slightly beyond the concaved surface of the porcelain on each side, and then perforating and burnishing a piece

Fig. 332.

of platinum foil over these exposed ends and around the entire lingual surface as a means of forming a backing.

When backed up in this way, and adjusted to position on the model the spaces between the teeth themselves, and the abutment pieces as well, will be lined with platinum, thus forming a matrix and admitting, when properly invested, of their subsequent union with solder.

In their final assemblage the investment mass shoud be no larger than necessary, and extremely well heated before attempting to solder, in order that the solder may grasp the short projecting ends of the wire. After observing these precautions the intervening spaces should then be filled well with solder, not permitting it, however, to flow over on the platinum which covers the lingual surfaces, as this is subsequently removed in the process of finishing. The principle of attachment and the result obtained in the finished piece are illustrated in Fig. 332.

While the purely cosmetic requirements are admirably subserved in the application of these teeth, yet the possibilities for obtaining strength in the metal superstructure which must support them appear to be limited, and, when this feature is combined with the possibilities of fracturing the porcelain in soldering which might easily be caused by the shrinkage of the solder, it would seem that, in view of better ones, this method is of doubtful practicability.

Bryan's Methods.

For the purpose of counteracting lateral stress in the application of fixed bridges the methods of construction suggested by Dr. L. C. Bryan, of Basel, Switzerland, may be somewhat novel and interesting.

These embrace a more radical use of the principle of the "saddle" than usual, and are recommended as being applicable to those cases where some support against lateral stress is demanded by the stability of the abutments.

Fig. 333. *Fig. 334.*

In bridges involving only one side of the arch where this condition exists, support is obtained by extending curved braces rootwise upon both the buccal and lingual sides of the alveoli, as high as they may be worn with comfort, and in as close adaptation to the tissue as it is possible to place them (Fig. 333).

Or, in cases where a bridge, or even single crowns, may present, or be required upon the opposite side of the arch, this support is obtained by uniting them with a heavy, well adapted, narrow saddle extending transversely across the palate as illustrated in Fig. 334.

By the application of either of these methods it will be observed that support against lateral stress is undoubtedly afforded, and while the principles involved may be practical for temporary purposes, or as an expedient, it would seem that the utility of such a type of construction is questionable for the reason that if the condition of the supporting roots demanded such provisions, a *fixed* bridge would rarely be indicated, and that the unhygienic conditions necessarily arising would be a menace to the comfort and health of the wearer.

Townsend's Method.

Another somewhat novel but very ingenious method combining the principles of both fixed and removable bridgework has been suggested by Dr. E. L. Townsend, of Los Angeles, Cal.

In this combination type of construction wide bands are first closely adapted around the entire circumference of the crowns of the supporting teeth—without giving them any preparation whatever—by means of pliers designed for the purpose. When the desired adaptation has been completed, the bands are removed and soldered. Gold dummies are now made to fill the space and to occlude, and the whole is then united with solder. When nicely finished the band and dummy on each end are

Fig. 335.

separated in such manner as to leave shoulder enough to accommodate a small screw when reapproximated, which may be done with a fine mechanical saw, and through each surface a hole is afterward drilled and then threaded. A small, short screw is now made and fitted into this, and when the adjustment is completed the band may then, and by this means, be locked to place on each tooth (Fig. 335).

While this method, of course, admits of obtaining an accurate fit to the tooth without injury thereto, and of the ready removal of the piece at any time, even though mounted with cement, still the advantages are so slight and the detail so intricate as to limit its usefulness.

Obsolete Procedures.

Descriptions of the innumerable methods of anchoring fixed bridges by means of simple bands, projecting ends of bars resting in cavities which are to be filled after the bridge is mounted, etc., etc., are purposely omitted for the reason that such methods when compared with modern procedures are not regarded as being of practical value.

Assembling, Finishing, Mounting and Repairing.

CHAPTER XXIV.

Assembling: Requirements, Anterior Bridges, Posterior Bridges, Saddle Bridges, Extensive Bridges, Soldering. Finishing: Engine Work, Lathe Work. Gold Plating. Mounting: Preliminary Requirements, Cement, Gutta-Percha, Repairing.

The features and procedures incident to assembling, finishing, mounting and repairing fixed bridgework are of importance almost equal to those involved in the study and application of the foundations, and should be observed in detail quite as fully as any other part of the process of construction, while it is manifest that a knowledge of the last is equally as essential.

Assembling.

Although the principles underlying the final assemblage of the various separate parts which comprise the structure have already been more or less carefully considered in the chapters on "Investing" and "Soldering," yet, the requirements as applied exclusively to bridgework will, nevertheless, be briefly described.

Requirements. When all of the parts have been completed to point of finishing, it is then first necessary to determine whether the case is to be invested on the model, or detached therefrom and invested separately, in which decision one is guided more or less by the size of the piece.

In large bridges or those involving three or more "abutment pieces," the danger of displacing some part or other in attempting to remove it from the model, usually indicates that the safest procedure is to allow it to remain *in situ* thereon.

This may be done by first securely uniting the various parts along the lingual surface with hard wax, and then further insuring the preserva-

tion of their proper relation by covering the exposed outer surfaces of metal and porcelain with a thin layer of investment material or plaster. (See Fig. 24.) When this is hard, the case, model and all, should be removed from the articulator, and the model trimmed down until only enough of it remains to hold the parts together. It is then ready to be invested. Even though the model be of plaster the small piece thus remaining will in no manner interfere with the process of soldering if it be completely covered with investment material.

In small cases where there are less than three abutment pieces it may be quite safe, and even preferable, to remove the parts from the model, thus preserving it, and invest separately. When this procedure seems desirable the abutment pieces should first be detached in such manner as to admit of their accurate replacement, then properly readjusted to position, the dummies also arranged in their correct place, and the relation sustained with hard wax, when all may be removed and invested.

Previous to the final arrangement on the model, if the surface between the "abutment pieces" be covered with tin foil to prevent the hard wax from clinging thereto, the ready removal of the parts after being thus temporarily assembled will be greatly facilitated.

An observation of the following additional precautions will contribute much to the successful investment of the case, whether it be large or small.

First, all parts to be exposed after investing should previously be well covered with wax as a means of indicating the surfaces which are to be ultimately exposed, and of keeping them perfectly clean.

Second, the *interior* of all "abutment pieces" *must be well filled* with plaster or investment material prior to investing, as a means of preventing the concentration of excessive heat which may fuse them.

Third, the investment should be trimmed down until no surplus beyond the *actual* requirements remains, and until all of the wax is exposed. This in turn facilitates the free exposure of the metal parts, and diminishes the degree of heat required to solder.

Fourth, the wax should be carefully removed with a small sharp pointed instrument, and any overhanging edges of the investment then trimmed away until the metal surfaces of both "abutment pieces" and dummies are *freely* exposed. Strength in the investment should be obtained from the under side in order to admit of this, and thus facilitate and expedite the process of heating up and soldering.

Fifth, the requirements of *contact* between the parts; of adaptation in the event of the use of connecting bars or wedges for preserving the

proper relation and insuring strength; of *flux*, and of preventing the solder from flowing where it is not wanted, should be observed before the case is heated.

Anterior Bridges.

In the assemblage of bridges involving the six anterior teeth it is always necessary to observe some means of insuring adequate strength in the union, and of preserving the individuality of the incisor facings by preventing the complete union of their backings from cervical to incisal end. Indeed, nothing so enhances the appearance of anterior bridges assembled with gold as avoiding a show of gold between the facings.

While it should first be observed that the backings do not come in direct contact *between the pins and the incisal ends* (which should of course be noted before the case is invested) this particularly desirable

Fig. 336.

feature may be best obtained by filling in between the incisal ends of the backings *before the case is heated*, with a thin solution of whiting. This may easily be done with a small pointed brush and will accomplish the purpose by preventing the solder from running into the joint and uniting the backings at these places.

As such a procedure will usually leave but a very small portion of the backings in contact, and to be united, extreme care must be observed to obtain the necessary strength in the assemblage. This may be insured, however, by fitting a piece of round iridio-platinum wire about 18 gauge, directly over or immediately under the pins, and across the backings from cuspid to cuspid, before the case is heated, and then allowing the solder to flow only over and around this wire from one end to the other. (Fig. 336.) Ample strength, and a better lingual contour will then result, and the cosmetic requirements will at the same time be highly subserved.

The former practice of placing thin pieces of *mica* between the incisal ends of the backings for this purpose is objectionable for the reason that it is frequently attached to the porcelain by the fusion of the

borax, and becomes exceedingly difficult to remove. Small pieces of paper or cardboard are also used in a similar manner, but, while they preserve a space between the facings, they do not prevent a union of the backings.

Posterior Bridges. No special precautions other than those mentioned are demanded in the assemblage of posterior bridges, except perhaps that the requirements of strength and contour must also always obtain. Both of these may be secured by using, in simiiar manner, an iridio-platinum wire of from 14 to 16 gauge, thus requiring less solder and insuring greater strength and better contour. In this connection it is always desirable to carry as small a quantity of solder to the melted state at one time as possible, in order to minimize shrinkage, and the value of the use of wire in this manner is therefore apparent.

Saddle Bridges. The use of wire as suggested will also be found particularly advantageous in the assemblage of saddle bridges because of the greater space between the saddle and the cusps which must be filled in order to have the desired lingual contour obtain. Globules of scrap gold may also be used, or, if desired, those of copper or german-silver, provided they are not melted so as to become alloyed with the solder, and also provided that they are completely covered with solder so as not to be exposed in finishing.

Extensive Bridges. Because of the shrinkage of solder, and of the fact that it is not always possible to entirely overcome or control it, the assemblage of extensive bridges involving all or nearly all of the denture, may invariably be best accomplished by first dividing them and investing and soldering in sections, and then subsequently uniting the sections.

In cases, for instance, which extend from the molars on one side to those on the other, if soldered all at one time the shrinkage may be so great, owing to the curvature, as to preclude the subsequent adjustment of the piece to its position in the mouth. Indeed in such cases this will be the usual result unless proper precautions are observed.

After the assemblage on the model, however, if it be divided at the median line and each lateral half invested and soldered separately, no difficulty will be experienced. Each piece may then be finished, and adjusted to position in the mouth, when an impression in plaster should be taken. This should be filled with investment material and the model obtained, after which it may be trimmed small and invested, and the two pieces then united in the center, when it will be found that they will go readily to place.

Soldering. All of the precautions incident to soldering which have been previously mentioned must be observed, but by way of emphasis it should be remembered that no effort to accomplish this procedure should ever be attempted until the case has been allowed to remain on the burner sufficiently long to become *thoroughly* heated. If the surfaces of metal and solder have then been properly fluxed, but little effort will be required, and the ordinary combination mouth blow-pipe will answer the purpose. While compressed air may be used by skilled hands, still it is easier to regulate and control the heat with the mouth blow-pipe, which is therefore manifestly more reliable and safer.

In the management of a large quantity of solder such as is required in assembling bridgework the procedure may be greatly facilitated by first cutting the solder into good sized pieces, and then using the sharpened point of an ordinary *slate-pencil* to pull, push or guide the solder when in a plastic state to the desired point, as recently suggested, and, in placing the solder, long pointed pliers may be used with more comfort, of course, than short ones. When considerable filling in between the parts is required, previously melting the solder into various sized globules, and then packing these into the spaces before fusing, will also facilitate and expedite the work.

Finishing.

Much of the artistic effect to be obtained in the construction of dental bridges will depend upon the manner in which the work is finished before mounting and many otherwise well constructed pieces lack those earmarks which stamp them as artistic productions simply because they are not properly finished.

While the *finished* bridge workman need not class himself, nor be classed, as a "dental jeweler," still his every piece of work should nevertheless be finished *like a piece of jewelry,* and he is not a "finished" workman nor even a good goldsmith unless it is.

This is not altogether a purely *cosmetic* requirement either, for the manner in which a piece of work is finished will have much influence upon its *hygienic* qualities, and therefore it is apparent that these combined requirements demand that proper attention be given to this part of the detail of construction.

The fact that the work of some operators never looks as well as that of others, of perhaps equal skill, may invariably be attributed to the further fact that the one will spend an hour, perhaps, to accomplish that

which the other would try to do in a few minutes. This time, however, is by no means wasted because well finished work will not only look better at the time when it is mounted, but by being well finished will *always* look better, for the reason that highly polished surfaces of metal will resist the chemical action of the secretions more permanently, and will also be more easily kept clean and therefore will be more hygienic.

Engine Work. In the process of finishing the first essential is to subject the piece to the acid bath and allow it to remain therein long enough to dissolve all particles of flux and investment material which may cling to it after soldering. When this has been accomplished the acid should be thoroughly removed with water and the piece then finished with small thin-edge carborundum stones used in the engine.

This preliminary process should be continued until all solder pits and inaccessible pockets have been more or less obliterated, and until the finishing lines between metal and porcelain are well defined, and all of the surfaces contoured as desired and perfectly smooth. Coarse, medium, and then fine emery or sand paper disks should be used until the deeper scratches are well removed, when the piece is ready for the lathe.

Lathe Work. As applied to the work to be done on the lathe every observable scratch should first be worked down with a fairly thin felt wheel and moistened pumice-stone until the piece is ready to be polished, when a stiff brush wheel and moistened whiting, or precipitated chalk, followed by the soft brush, and then by the "buffer" will result in imparting the high degree of finish which is desirable, and a few minutes thus expended will be productive of the advantages mentioned.

Rouge and other jeweler's polishing compounds are frequently recommended, and while not objectionable the polish obtained by the proper use of whiting is generally preferable, and the lathe work cleaner.

Gold Plating. Nothing adds more to the highly artistic appearance, nor to the permanency of the finish, than to subject the piece to the gold-plating solution after it has been well polished. This imparts a uniform color to the metal parts, and a resistance to the chemical action of the secretions, which is not otherwise obtainable, and will be more or less permanent in accordance with the number of times that the piece may be removed from the solution, repolished with the buffer and whiting, and then replaced therein. Two platings with a good polishing in between them, however, will usually suffice.

While the details pertaining to this particular phase of the subject

have received a more complete description elsewhere (see page 288), a simple and inexpensive apparatus to be used in combination with the commercial plug known as the Teter Tap, has been suggested by Dr. C. S. Case, of Chicago. In the use of this the current may be taken directly from the socket which supplies it for illuminating purposes, the resistance being obtained through the use of an *eight* candle power lamp in serial connections therewith.

Mounting.

Few of the details incident to the application of fixed bridgework are more important than those involved in properly and securely mounting it in the mouth, and this procedure, therefore, requires painstaking care.

Preliminary Requirements.

Preliminary to the final mounting it must of course always be first ascertained that the piece goes readily and accurately to place, and that the occlusion is correct.

In this connection it not infrequently happens that some difficulty may be encountered in adjusting the piece to its proper position because there may not be perfect parallelism between the abutments, which may not have been noted in the construction of the abutment pieces, and which does not become apparent therefore until effort is made to adjust the assembled piece.

Indeed it will sometimes seem as though a proper adjustment would be quite out of the question, until by gradually and carefully enlarging the *openings* of the canals for dowel crowns, or by further grinding away from the interfering approximal surface of a posterior abutment, or both, the piece may finally be slipped over and forced to place. In these instances extreme care and even more than moderate patience may be required, but painstaking persistence will usually result in effecting the proper adjustment.

When this has been obtained the occlusion should be noted and if alterations are necessary they should be made at this time by removing, grinding and then readjusting until a degree of accuracy obtains, which will insure comfort and usefulness, and then such surfaces as have been ground should be again polished.

Because of the discomfiture which may result from the wearing—even temporarily—of a bridge which does not occlude properly, together with the danger to the porcelain teeth or facings thereby offered, the patient should under no circumstances ever be dismissed until the occlusion of the piece has been made perfect, and all undue stress relieved.

While it is permissible to finally and permanently mount all small bridges as soon as these requirements have been observed, in larger cases, where two or more abutments are involved, it is *always* the best practice to have the patient wear the piece for *one* or perhaps *two* days before finally and permanently mounting it. By so doing the roots and abutment pieces become adjusted to their proper relation with each other in such manner as to greatly facilitate the final procedure, and better opportunity is thus offered for observing and remedying any slight imperfections which may exist. Unless mounted with some temporary medium, however, such as "temporary stopping," it is never advisable to allow the patient to wear a bridge longer than two days, because in this time it will become foul, and get loose, and the accuracy of the adaptation of the "abutment pieces" may thus become destroyed by the mobility.

When these preliminary requirements have been observed, and the ready adjustment of the piece is thereby insured, both it and the abutments should then be prepared for the final and permanent mounting.

Cement.

In typical bridges if *cement,* which is recognized as being, perhaps, the most permanent medium, is to be employed the first precaution necessary is to observe some means of precluding or diminishing the attending discomfort which results from the irritating influence particularly of the oxyphosphate cements. This may be accomplished by the topical application of a 2% solution of cocaine around the abutments, or by painting the interior surfaces of the bands with 95% carbolic acid, and forcing the piece to place and allowing it to remain for a few moments, as previously recommended in connection with the mounting of crowns.

The abutment pieces should then be thoroughly dried with hot air, and the dowels covered with gutta-percha, temporary-stopping, or varnish, in accordance with the requirements in this connection which have also been previously mentioned in connection with crown work.

When the piece is thus properly prepared, the abutments should be rendered aseptic by the free use of absolute alcohol, and subsequently dried with hot air. As a means of keeping them dry during the procedure the cheeks or tongue should be kept away, and for this purpose the non-absorbent aseptic cotton rolls prepared by Johnson and Johnson will be found particularly useful, and these may in many instances be held in place with the clamps designed by them for the purpose. (Fig. 337.)

The cement should now be mixed (preferably by an assistant) to a thick creamy consistency, and the canals first filled, and then the abut-

ment pieces, when the bridge may be gently and gradually forced to place. As soon as the adjustment has been made the patient should be immediately required to close the mouth firmly in order that the operator may ascertain that the proper relation has been obtained, and that the occlusion is correct, and when it is found to be as desired, a *firm* closure should be maintained for a period of five or ten minutes, or until the

Fig. 337.

cement may have had opportunity to become fairly well crystallized before the piece may be subjected to the influence of stress in a lateral direction.

After the lapse of a few minutes for this purpose, a more complete crystallization may then be hastened by a spray of hot water, by hot air, or by any of the electrical heating devices, when all of the surplus should be carefully removed.

To insure the thorough removal of all surplus and thus avoid the subsequent irritation which may be induced by hidden particles, silk floss should be used between and around the abutment pieces in such manner as to dislodge any nodules which may remain under or within the free margin of the gum, after which the topical application of campho-phenique as a healing agent will be found beneficial.

In the event of the previous filling of the root canals of an abutment, by another operator and at another time, remote or otherwise, they

should nevertheless always be closely examined by the one who constructs and permanently mounts the bridge, for only by this means may it be ascertained that they are well filled, and this is imperative for the reason that one thus assumes the responsibility for conditions which may have to do with the permanency and comfort of the piece.

While several methods and appliances for excluding moisture during the mounting of fixed bridges with cement have been devised, none of them serves the purpose better than the one mentioned, nor is any other so universally applicable.

Saddle Bridges. In the mounting of saddle bridges with cement the greatest possible care must be exercised in order to preclude forcing the cement in between the saddle and the tissue, and to avoid the irritation which will result therefrom after crystallization.

Indeed, as a general rule, it is so difficult to provide against this with any degree of certainty, that it is invariably the best practice to mount such bridges with gutta-percha.

Where cement is used, however, the possibilities of subsequent irritation may be more or less largely overcome by first coating the surface of the saddle with *gum acacia* dissolved in water, as suggested by Dr. G. W. Whitfield. This hardens more or less readily, and the cement will then be forced out from between the saddle and the tissue, hence any adhesion of it to the surface of the saddle is thus prevented. It may also be advantageous to place the immediate center of a piece of fine waxed silk floss of considerable length over the saddle, before mounting, and then subsequently removing any cement by drawing this backward and forward across the saddle from one end to the other, while the patient maintains a firm inclosure upon the bridge. Aside from these or similar precautions the procedure as above mentioned should be observed in detail.

Gutta-Percha. The use of gutta-percha as a mounting medium for all types of fixed bridgework is becoming more and more general in proportion as its advantages are recognized, and its manipulation is mastered, yet in its present form it is doubtful if it will soon, if ever, entirely supersede cement. or if it offers the same opportunities for permanency.

Advantages. The advantage offered by this form of mounting lies mainly in the comparative ease with which the bridge may be subsequently removed in the event of necessity, and without injury to the abutments, supplemented by the relief afforded to the porcelain part on account of the more

cushion-like effect obtained because of its possible elasticity as compared with cement, and by the absence of any cause for irritation since no surplus, outside of the actual requirements, need obtain.

Application. In the application of gutta-percha as a mounting medium, the ordinary pink base-plate material seems to offer the greatest opportunity for permanency, because of its inherent toughness and durability. In its use it should be cut into small narrow strips for dowel crowns, and small square pieces for telescope crowns, and as it can only be manipulated at a temperature which will admit of ready and accurate adjustment,

these should then be placed on a smooth surface of hot iron, or of some heating device which avoids contact with the flame, until the greatest possible plasticity is obtained. Fig. 338 illustrates a heating device designed for this purpose by Dr. Geo. Evans, and a simple, neat and inexpensive little electric heater has been devised by Dr. A. H. Wallace, of San Francisco.

When the piece involves a dowel crown, if the dowel is smooth its sides should first be serrated or roughened with a sharp cutting instrument, and then moistened with oil of cajaput, or eucalyptus, as a means of obtaining attachment thereto, and one of the plastic strips then coiled around it and molded to closely follow its form with the fingers. The bridge should now be placed upon the heating device and allowed to remain until this is again plastic, when, after moistening the canal with water from a small syringe, or some essential oil, to prevent the gutta-percha from adhering thereto, the bridge should be forced to place.

This procedure should be repeated until enough of the material to completely fill all of the space between the crown or abutment piece and the root has been added, and no surplus, beyond this, remains, and

the same procedure should then be repeated for the telescope crowns excepting that in this type of crown the small square pieces are used instead of the strips, and these are placed in the cusps and around the band, the surfaces of which should previously be roughened or serrated with a sharp instrument.

When a sufficient quantity of gutta-percha has thus been moulded into each abutment piece *separately*, the bridge should again be placed on the heater, and the abutments then dried with alcohol, and subsequently moistened with a thin solution of gutta-percha in cajaput or eucalyptus, when the piece may then be finally forced to place.

This solution is used as a means of facilitating a more secure attachment of the gutta-percha to the roots, and may be easily made by first dissolving the material in chloroform—which is a more ready solvent—and then gradually adding the cajaput or eucalyptus as the chloroform becomes evaporated until a stable solution of the proper consistency obtains.

Because of the refractory properties of base-plate gutta-percha, and in order to overcome this, and thus simplify the manipulation, various so-called "gutta-percha cements" are now manufactured and more or less extensively used, and the outfit of this kind suggested by Dr. Geo. Evans is very complete. Although such preparations may be found useful, still the increased plasticity and a possible shrinkage, together with the influence of normal temperature, makes the permanency questionable, and therefore, since it is these same refractory properties which enhance the value, and insure the maximum durability of gutta-percha as a mounting medium, the best and most permanent results are doubtless to be obtained from its use in the manner indicated.

Repairing.

So long as porcelain facings are employed, faulty occlusions are allowed to exist and remain faulty; for purely economical or other reasons the requirements of strength are not religiously observed, and patients are not cautioned to, and do not exercise moderate care, the occasional repair of fixed bridgework will become to be a necessity. For these reasons it is evident that the operator must possess a knowledge of the procedures incident to effecting repair in the best and most expedient manner.

Fractured Facings. Perhaps the most common accident which happens to fixed bridgework is the fracturing of porcelain facings, but unless this is accompanied with other complications which demand the removal of the piece, the pro-

cedure is usually comparatively simple and easy, and, as applied to bridgework, is identical with that incident to the replacement of single facings as previously considered at some length in connection with crown work. (See page 176.)

While one or even two facings may be replaced by any of these previously mentioned methods, still, when the replacement of more than two on the same piece is demanded, it is usually best to remove the bridge, obtain models, and attach the new ones by backing them up and soldering.

Removing and Soldering.

When the removal of the bridge is demanded as a means of affording opportunity for thus attaching new facings, or for effecting repair of the metal parts by soldering, the greatest care must be exercised to avoid inflicting unnecessary pain upon the patient, and to preclude the possibilities of doing injury to the supporting roots.

For this reason it is necessary to first break or destroy the fixity of the attachment of the abutment pieces. In this connection the shell or telescope crowns should first be loosened, and if it be desirable to preserve the continuity of the band in order to admit of subsequently replacing the crown, this may best be accomplished by means of drilling a small hole under the cusps, and lifting it upward or downward with a heavy pointed instrument as previously described in connection with Fig. 114, until it is loosened. If the crown is not to be used again the crown-slitting forceps, if preferable, may be used for this purpose. The dowel crowns should then be likewise loosened in their attachment, but unless this may be accomplished by the degree of mobility afforded by the loosening of the other end, and by the gradual working of the piece, the procedure is considerably more difficult, and may require that the dowel crowns be first separated from the remainder of the bridge, which may be done with a thin edge carborundum stone; or else that the dowel be separated from the cap by neans of a small stone and then a bur, used in the engine, as also previously described in connection with crown work. (See page 184.)

As soon as all of the abutment pieces are thus loosened the piece may be detached and all remaining cement then removed with a suitable bur, after which it should be subjected to the acid bath and allowed to remain therein until perfectly clean.

If much mutilation of the crowns has resulted they should be separated from the piece with a fine mechanical saw, and then repaired, or replaced by new ones. After repairing the old ones, or constructing new ones, they should be adjusted to place on the abutments and an impres-

sion and model obtained, after which the remaining parts may be assembled on the model and the caşe invested and soldered.

Where broken facings are to be replaced by new ones, the old backings should be sawed out, and the remaining parts placed in position in the mouth and an impression and model obtained, when the new facings may be selected, ground to fit, backed up, and the case then also invested and soldered.

In order to facilitate the repairing of bridges which have been worn, by means of soldering, however, it is always necessary to observe that absolute cleanliness of the parts has been effected.

Porcelain Bridgework.

CHAPTER XXV.

Indications. Requirements. Application and Construction: Anterior Bridges, Posterior Bridges, Dowel Crowns as Abutment Pieces. All Porcelain Dummies: Making Porcelain Blocks, Building, Carving and Baking, Repairing.

The application of porcelain to the construction of bridgework may be recorded as being among the early achievements of modern dental ceramics, and while still perhaps in a more or less uncertain stage of development, it has nevertheless always been regarded by those who recognized its cosmetic and hygienic possibilities, as the ideal type of prosthesis.

Unfortunately, however, an early wave of enthusiasm following its introduction by Land, Parmley Brown and others, led to such general and indiscriminate use as to bring grief and discouragement to those who became overzealous, and who, while quick to appreciate its possibilities, were equally slow in recognizing its limitations.

As a result, a very large proportion of the primitive efforts in this direction were such signal failures as to dishearten even the most sanguine, and the progress and development which had previously seemed so desirable and so certain was thereby materially retarded.

For the reason that purely *cosmetic* and *hygienic* "possibilities," however, do not encompass the entire range of the requirements of dental bridgework, such a result was but a natural sequence essential to the experimental stages, and, since it is largely by our failures that we learn, this era of disaster and discouragement was by no means unproductive, for it served to develop the faculty of reasoning, and the power of discrimination to an extent which awakened recognition of the fact that porcelain has its limitations.

If it is conceded that all of the combined requirements in the composite—and to the highest possible degree, must obtain in any class of work destined to be permanently successful; that porcelain is a vitrious and friable substance, by no means indestructible, and that inherent *strength* is one of the prerequisites of bridge construction—all of which are indisputable—it is then evident that porcelain work is not universally applicable, and that when it is chosen a degree of strength commensurate with the requirements must obtain.

On the other hand, and irrespective of these facts, its application embraces so great a field of usefulness as to insure its permanency as an art, and this field, circumscribed though it may be, will increase in proportion as the aim for higher artistic attainment is cultivated and developed, and in proportion as a more definite knowledge of the limitations may be recognized, and the actual requirements observed.

Success or failure will therefore depend largely upon two factors; first, upon *judicious* application, and second, upon an observation of such details of technique as are essential to insuring a maximum degree of strength in the finished piece.

In order that the application may be judicious, however, it is obvious that the conditions must be favorable, and when they are not, or may not be made so, porcelain can not be a conservative reliance and is therefore contraindicated.

Indications.

In studying the conditions which are favorable to the application of porcelain bridgework, the inherent physical characteristics of this vitrious, friable substance must be recognized, and whilst it is capable of withstanding stress to a degree, the stress to which it may safely be subjected will increase in proportion as its thickness or "bulk" may increase, and will decrease correspondingly.

It is therefore evident that the application of porcelain bridges is indicated only in such cases as present an extent of absorption and an occlusion which are favorable, or, in other words, a condition where ample space exists, for only under such circumstances may opportunity be afforded for the use of sufficient bulk to prove adequate to the demands for integral strength.

Removable Bridges.

As the extent of absorption increases in proportion to the length of time elapsing since the loss of the natural teeth, together with the number which are missing; and as the application of "fixed" bridges to very extensive cases is rarely indicated, it is apparent that porcelain bridgework is more

generally applicable to *removable* structures where ample space, support and protection is afforded, than to bridges which are designed to be permanently attached to the supporting teeth, and when the application is confined to this class of construction the very highest type of cosmetic, hygienic and serviceable prosthesis may be obtained.

Fixed Bridges. Under the same or similar conditions the application to "fixed" bridges, to which this chapter will be entirely devoted, may also be equally practicable, and offer the same advantageous features. In this connection, however, every opportunity for observing all of the combined requirements *must present*, and even then the most successful results will obtain by confining the application to smaller and less extensive bridges, or to parts of bridges in combination with gold.

Requirements.

Coincident with favorable indications the fundamental requirements of successful application demand a degree of judgment equally sound, and a degree of knowledge equally broad, and these must then be supplemented by a particularly painstaking observation of details. Indeed, in perhaps no other one class of mechanical procedure must every part of the technique be so carefully observed as in porcelain work, and a recognition and appreciation of this fact at the very outset, will form an impregnable fortification to the stronghold of ultimate success, for all whose ambition leads them in this direction.

Regardless of the previously mentioned more or less unfavorable characteristics of porcelain, a far greater number of failures in this type of bridgework can be attributed to an inadequate degree of knowledge, or to an indifferent observation of the details in connection with the requirements, than can ever be traced directly to the faults of porcelain itself. In fact almost any of the various makes and grades of porcelain compounds possesses the necessary strength and may be successfully used provided the proper attention be given to the construction of the metal parts which are to form the substructure, before the "body" is added thereto.

Therefore, while it is true that much also depends upon the character of the porcelain selected, and still more upon its proper manipulation, yet since it is at best but a friable substance, and since little or no physical union obtains between it and the supporting structure, it is evident that the practicability of this class of work will always depend largely upon the support and protection afforded to the porcelain by the substructure.

Substructure. For these reasons the substructure must necessarily be constructed in such manner as to afford a *strong, unyielding, well-adapted base* which will, first, mechanically sustain and support the porcelain part of the piece; and second, which will protect this porcelain against cleavage, and from the influences of stress, in all directions.

While the employment of platinum is of course necessary as a means of insuring a degree of infusibility which will withstand the temperature required to fuse any of the porcelain compounds used for this purpose, the requirements of strength not infrequently indicate the use of iridio-platinum; and all of the various parts must then be assembled in a manner which will preclude the possibility of any subsequent change in their relation as a result of the shrinkage of the "body" in fusing.

Pure Gold as a Solder. The assemblage of the various parts of a bridge with *pure gold* as a solder, which was the former and is the common practice, has proven to be entirely inadequate to these combined requirements, when any of the higher fusing "bodies" are used. This is due to the fact that its absorption by the platinum at its melting point, or its volatilization at a higher temperature, or both, to which gold is susceptible in the furnace, absolutely precludes the making of strong joints, or of any reinforcement, and for this reason does not prevent a change of form as a result of the shrinkage.

Platinum Solder. Such a possibility may be entirely overcome, however, and adequate strength insured by using 25 per cent. platinum solder throughout the construction of the entire substructure, and including the attachment of the facings. As this alloy is ordinarily not disturbed in the fusing of the "body," a secure, strongly reinforced and reliable assemblage may thereby be effected, for which reason its use is universally recommended.

Providing for Strength of Porcelain. As a further means of insuring and providing for strength, the adjustment of the parts constituting the substructure must be made in such manner as to avoid unnecessarily diminishing the strength of the porcelain to be subsequently applied. This may be accomplished by keeping all of the metal parts in such close proximity with each other as to preclude dividing the mass of porcelain through its center, or into small sections, which is always an element of weakness and must be avoided.

Porcelain Compounds. If the requirements of the metal substructure are thus observed it is evident that but little strength in the porcelain itself will be actually required, and

hence, as previously stated, various grades of these compounds may be successfully employed if properly manipulated.

Owing to the excessive shrinkage of the so-called "low" fusing bodies, however, as compared with the less fusible compounds, the requirements of bridgework, where so large a quantity is to be used in obtaining contour, and where stability of form and color are so essential, will be best conserved by the employment of those classified as "high" fusing.

This is manifest for the reason that a minimum of shrinkage, combined with a maximum degree of stability of form and color, must necessarily facilitate and expedite the procedure. And those readily apparent advantages may also be still further increased by using *one grade* of "body" throughout the construction of the piece, instead of beginning with the so-called "foundation" and finishing with "enamel," for the reason that in the use of one grade, a more uniform shrinkage will prevail, and therefore if the piece is built up to the desired form and contour for the first bake, *two* fusings will usually be sufficient to complete the case, while in the use of two grades the uneven shrinkage will usually require three, or more, to produce the same finished result.

Application and Construction.

While all of the fundamental principles and requirements incident to the application and construction of fixed bridgework in general apply also, and with equal emphasis, to porcelain work in particular, yet, in addition thereto it must also be remembered that the details of construction should be even more closely observed, and more carefully executed.

If these considerations are recognized as being essential to success, and the application is made in accordance therewith, the scope of practicability, and of cosmetic possibilities, will be limited only by the capability of the operator to exercise judgment in the application, and to acquire skill in the details of construction.

Anterior Bridges.

Since the cosmetic requirements are of course confined mainly to that area of the arch which is within the range of vision, it is evident that the greatest demand for porcelain bridgework will be in such cases as involve the replacement of any of the ten or twelve anterior teeth, but as applied particularly to all, or to any part of, the *six* anterior teeth *two* general types of construction are employed, though each one is subject to many variations.

These differ from each other *only* as relates to the use of a "saddle," and while the best results in porcelain bridgework are usually to be obtained by utilizing this principle, there are cases where the extent of absorption which has taken place would not indicate, nor admit of, the use of a saddle, and where the more simple form of construction would thus become necessary. It must be remembered, however, that even though a saddle may not be indicated there must, nevertheless, be room enough for a strong mass of porcelain or this type of bridge construction is contraindicated.

Methods of Attachment.

In either of the above-mentioned general types the methods of attachment to the supporting teeth must, as usual, be first determined, and their adaptation then effected.

While inlays made of 25 per cent platinum solder and applied in accordance with the requirements previously mentioned, or, some of the various other forms of attachment—also made with platinum solder—may sometimes be used to advantage still the possibilities for reproducing the natural crowns, together with the additional strength and greater permanency afforded by the use of artificial crowns, will usually indicate the more or less general choice of the latter as "attachments" or "abutment pieces."

Porcelain Crowns.

When crowns are used the roots should be prepared as usual, and the platinum cap, including the dowel, completed as previously indicated for single porcelain crowns.

Because of the additional requirements of strength incident to bridge construction, however, the band—if one is used—should be at least 28 g., and the floor in either instance should not be thinner than 32 g., and while the union of the band, the floor and the dowel may be made with pure gold—without precluding the subsequent use of platinum solder in the final assemblage of the piece—*if absolute contact exists*—nevertheless, the safest results will usually obtain from the use of platinum solder for this purpose also; and where a band is used the joint should invariably be *lapped* in either event, as a means of precluding the possibility of its opening in the furnace, as well as of insuring a maximum degree of strength.

Typical Construction.

In the construction of small, simple bridges in the anterior part of the mouth the use of a saddle beneath the dummies is rarely indicated unless demanded by excessive absorption and as a support for porcelain for gum restoration.

Without Saddle. When a saddle is for this reason unnecessary, or contraindicated, the caps, or other abutment pieces, should first be completed and then placed in position upon the roots or supporting teeth, properly adjusted in their relation thereto, and the final "bite" and impression taken.

As the preservation of the model throughout the construction of porcelain bridges is quite essential, the interior of the caps when removed in the impression should always be filled with wax as a means of facilitating their subsequent removal and accurate replacement when the model is obtained, and this feature should be observed irrespective of the style of abutment piece employed.

After obtaining the model, adjusting the bite, and mounting upon the articulator, suitable facings should then be selected, and ground to fit the caps and the intervening model, and to the proper relation with each

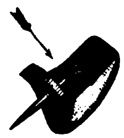


Fig. 339.

other. In this connection at least two precautions are necessary. First, the facings which are to be adapted to the caps must be ground thin enough to overlap upon *the labial surface of the bands,* for the reason previously mentioned (Fig. 339); and second, some little space should always exist between the facings in order to admit of their expansion during the process of soldering.

When the desired adjustment has been obtained the caps should be slightly warmed and detached from the model and then held in the flame until the wax is removed from them. After observing that they then go readily to place, and that they may also be easily removed, they should be adjusted to position and the surface of the model between them covered with tin foil. (Fig. 340.) The facings should now be properly adjusted and securely attached with hard wax, after which the entire piece may be easily removed from the model (owing to the presence of the tin foil) and invested.

Investing. Except that the *entire lingual surface* of all of the facings must be freely exposed, and that the investment must have body enough to hold it together and to withstand the stress necessary to properly adjust the pins

to the connecting bar, the requirements incident to investing porcelain bridges do not differ essentially from those in general, but these precautions must be observed.

Fig. 340.

When thus invested the wax should be carefully removed and all thin overhanging edges then trimmed away until the facings are freely exposed. (Fig. 341.)

Fig. 341.

Connecting Bar. A connecting bar of round iridio-platinum wire not smaller than 16 g. should now be adjusted, and as the strength of the finished bridge will depend largely upon this, it is therefore evident that an adjustment such as will insure strength must obtain. In effecting this the bar should first be bent so as to approximately follow the curvature of the facings, and then cut the proper length. The ends should now be flattened on the anvil and trimmed so as to rest firmly on each cap, up close to the facings, both of which provisions are for the purpose of obtaining strength without materially weakening the porcelain. (Fig. 342.)

Ordinarily, however, where a saddle is not used, this bar should not come in direct contact with the *intermediate* facings, or dummies, but should be so adjusted as to admit of bending the pins down until their ends come in contact with the bar, and yet leave some little space between it and the facing. (Fig. 343.) This is desirable for the reason that where no saddle is used it is seldom if ever advisable to attempt to completely cover the bar with porcelain, as it would be likely to chip off

Fig. 342.

afterward, and that if some little space exists opportunity for effecting the necessary contour and for obtaining the necessary strength in the finished piece without completely covering the bar, is thus afforded.

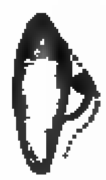


Fig. 343.

When the bar has been so adjusted, each pin of each facing should then be bent, usually downward, or toward the cervical, until *absolute* contact with the bar is obtained. This may be accomplished by securely holding the facing against the investment with a blunt instrument in one hand, while the pin is bent with a sharp instrument in the other, being careful always to apply the pressure to the extreme end of the pin and to hold the facing securely.

If absolute contact is impossible a small piece of platinum plate or wire should now be fitted into the space, as a means of facilitating the subsequent union with solder, and if the bar is not inclined to remain in place and preserve the contact thus obtained small pieces of investment

material or fire-clay should be fitted so as to support it and thus insure a preservation of the contact when the case is heated for soldering.

When all of these requirements have been carefully observed the case should then be placed upon the flame and allowed to remain until thoroughly heated, after which the parts should be united with 25 per cent platinum solder, being careful to observe that every pin is securely attached to the bar, and that the ends of the bar are then also securely attached to the caps. The completed substructure for this type of bridge is illustrated in Fig. 344.

This same general type of construction would also be equally applicable to the support of the four incisors by the two cuspids, or, in favorable cases, may even be further extended on one or both sides so as to involve the bicuspids, but, in this latter connection it is well to remember that the practicability of porcelain bridgework diminishes as the size of the piece increases, and that small bridges will therefore be more

Fig. 344.

successful than large ones, unless the latter are made in combination with gold.

Other typical styles of construction where no saddle is employed, and which are more or less practicable, are illustrated in Fig. 345.

With Saddle. In such cases as demand the use of a saddle because of the necessity for gum restoration due to excessive absorption, the application must be made in accordance with all of the various requirements previously considered in connection with "saddle bridges," in conjunction also with those essential to porcelain work.

This type of construction in a typical case which involves the cardinal principles is illustrated in Fig. 346.

Posterior Bridges.

Notwithstanding the apparent objections to the saddle in "fixed" bridgework, and the tendency to avoid its use whenever and wherever

Fig. 345.

Fig. 346.

possible, it must nevertheless be remembered that where the porcelain part of the structure is to be subjected to masticatory stress, some means of protecting and supporting it *must* always be provided.

Without Saddle.

Failure to properly appreciate and observe this requirement only means failure in the application of porcelain bridges to the posterior teeth. The type of construction which was used prior to a recognition of this fact, but

Fig. 347.

which has been abandoned because of the proportion of failures which invariably presented, and in which the entire occlusal surfaces of porcelain became fractured and broken away by the stress of mastication, as a direct result of being inadequately supported and protected, is illustrated in Fig. 347.

Typical Construction.

For this reason it is apparent that if porcelain bridgework is to be used in replacing posterior teeth, the use of the saddle is invariably essential to its successful application, and as applied to posterior bridges, about the only exception to the rule is in those simple and quite common cases where the second bicuspid is used to support the missing first bicuspid, and where the presence of cusps upon the tooth thus suspended is usually unnecessary. The type of construction which may generally be used with success in this particular class of cases is illustrated in Fig. 348, but in the baking of such cases no effort should be made to entirely cover the projecting end of the connecting bar which supports the dummy, with porcelain, for it would be certain to chip or creak away unless made unusually and objectionably clumsy.

With Saddle.

While the details incident to the construction of posterior bridges in porcelain are, of course, subject to many modifications and variations, the saddle is thus essential, and the underlying principles are practically invariable, and may be elucidated in a general way by the presentation of typical cases.

Methods of Attachment.

As mentioned in connection with the construction of anterior bridges, while inlays made of twenty-five per cent. platinum solder, or any of the various other forms of attachment to the supporting teeth which,

when also likewise made, may seem to offer opportunity for obtaining permanency, and may therefore be sometimes used, the best results, particularly in posterior bridges where the stress is greater, will usually obtain from the use of either dowel or telescope crowns as the abutment pieces, for the reason that the durability of the piece is thereby increased.

Dowel Crowns. When porcelain dowel crowns are to be used on one, or both, ends the caps with or without a band, as may be preferred, should first be made and fitted in the manner indicated. When completed these should be placed in position on the roots and a plaster impression taken, from which the die and subsequently the counter die may be made. (See Fig. 299.)

Fig 348.

The saddle should now be swaged of 30 to 32 gauge platinum, trimmed to the proper outline, fitted in the mouth with the caps in place, and then soldered thereto with platinum solder as indicated in "*saddle bridges*" in the preceding chapter.

When the metal framework is thus completed it should be placed in the mouth and the edges of the saddle burnished to a close adaptation to the tissue upon which it rests, after which the "bite" and impression should be taken.

The interior of the caps should now be filled with melted wax—in order to admit of their removal from the model—and the model should

then be made, the wax "bite" properly adjusted to it, and the case mounted upon the articulator.

Without Facings. While the entire porcelain part of the bridge may be built up with "body," and suitably and more or less artistically carved, after making provision for its mechanical support by and retention to the base or substructure, the use of facings is universally recommended. Indeed, as a means of obtaining proper form and color, their use, wherever possible, is essential to the achievement of the most artistic results.

With Facings. When suitable facings have therefore been properly selected and are then ground to the required adjustment, they should be temporarily but securely assembled with hard wax, and the entire piece removed from the model and invested in accordance with the requirements.

Connecting Bar. The connecting bar, which should be of round iridio-platinum wire from 14 to 16 gauge, should now be fitted *under the pins* and as *close to the saddle and facings* as possible, with each end resting firmly upon the caps, and

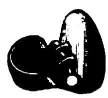


Fig. 349.

when so adjusted each pin should be bent down until *in direct contact* with the bar. Where such contact is impossible a small piece of wire or plate should be snugly fitted into the space between the end of the pin and the bar, in order to facilitate soldering and to insure strength.

Owing to the difficulty of bending iridio-platinum wire of this size to conform to such adaptation, Dr. W. H. Taggart has suggested a means of facilitating the procedure by twisting several pieces of small platinum wire, such as is used in electric furnaces (28 or 29 gauge), into a "rope" of suitable size, and after adjusting this to the requirements, subsequently filling it in with platinum solder in the assemblage of the parts. This will answer the purpose nicely, but is not so strong as a drawn wire.

Lingual Support. When the connecting bar has been thus adjusted, a means of insuring adequate support and protection to the porcelain which is to form the masticating surfaces should then be provided.

This may be observed to the best advantage by fitting small strips of 28 gauge platinum plate to the lingual edge of the saddle, immediately back of each facing, as also recommended in the construction of single

crowns. These may be bent to fit more or less closely upon the saddle, and when soldered thereto will form a lingual outline for contouring the porcelain, and a cup-shaped receptacle for its support and protection. (Fig. 349.)

To facilitate the retention of these separate pieces in their proper relation to the saddle while soldering, they should be so adapted as to allow the extreme edge of the saddle to project slightly beyond them. This forms a narrow shoulder upon which the solder may be placed, and when the assemblage has been completed, this edge may be finished down to a flush and even joint.

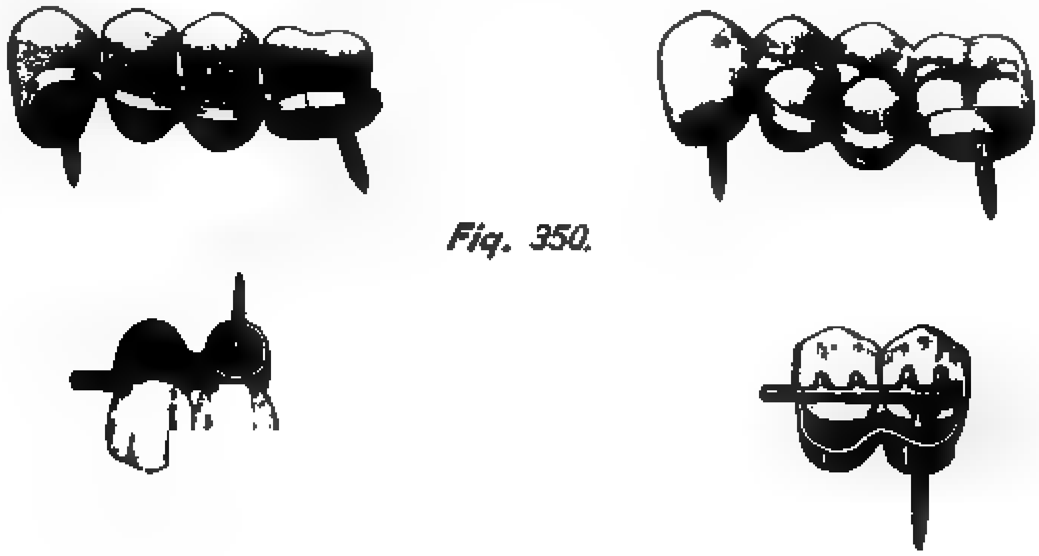


Fig. 350.

The width of this lingual extension or support may vary from 1-16 of an inch to a distance equal to half the length of the facings used, or even greater, and may furthermore be swaged in one piece, by means of an impression and dies, if desired, but the former width is usually all that is required, and a better conformation to the form of the saddle can usually be obtained by using separate pieces instead of attempting to adapt a single piece.

In effecting the final assemblage sufficient solder to make good joints and insure adequate strength should always be used.

This type of construction, which is applicable to short bridges in the upper jaw, is illustrated, in the metal and in the finished piece, in Fig. 350.

Another more simple application involving the support of a missing second bicuspid, by means of a dowel crown upon the root of the first bicuspid, and a support in the first molar is illustrated in Fig. 351. For the reason that the second bicuspid should usually be provided with an occlusal surface, the use of a small saddle beneath it and of some form of support on the posterior end is therefore made necessary. This support may be obtained by allowing the projecting end of the connecting bar to simply rest snugly in a gold inlay or filling previously inserted

Fig. 352.

and grooved for its accommodation—as illustrated and mentioned in the chapter on "fixed bridgework," or, it may be obtained by means of an inlay made of twenty-five per cent. platinum solder and constituting a part of the assembled bridge.

Convex Saddle.

Another type of construction involving the use of a *convex* instead of a *concave* saddle, designed for purely hygienic reasons, may frequently be found useful, and is particularly applicable to the lower arch where considerable absorption has taken place, and yet where complete restoration, *bucco-lingually,* is not demanded.

In the construction of bridges of this character a half-round or "D" shaped iridio-platinum wire about 12 or 14 gauge, or smaller if desired, may be used, and the convex side should be bent or swaged on a metal model to conform as closely as possible to the ridge upon which it is to rest, and each end then adapted to a close joint with the caps.

Additional strength in the substructure is to be obtained by bridging in between the connecting bar and the saddle, especially toward the center, with small pieces of wire, previous to soldering, and indeed this feature is often essential in long bridges where this or any other form of saddle is employed. (Fig. 352 A.)

When the assemblage of the substructure is completed the porcelain is then built down to the edges of the saddle, both labially and lingually, but no effort to cover it should be made. (Fig. 352 B.)

Telescope Crowns.

In short bridges, and especially in the upper arch, where the *first* molar is used as the posterior abutment, the cosmetic requirements usually indicate the use of a dowel crown, and yet, and particularly in more extensive cases where the *second* or *third* molar is to be thus utilized, it is often best to use a shell or telescope crown upon this end of the bridge in preference to sacrificing the supporting roof to the extent demanded by a dowel crown.

Therefore whenever the cosmetic requirements will admit of, or wherever the mechanical demands seem to indicate the use of the telescope crown on the posterior end, in conjunction with a dowel crown on the anterior end, such a type of construction should be chosen.

Fig. 353.

Platinum Crowns.

Where such crowns are to constitute a part of the metal substructure before the porcelain is applied, it is obvious that they must be made of platinum in order to withstand the heat of the furnace.

Furthermore, in order to be sufficiently strong, they should be made of at least 28 gauge platinum, and the cusps should be attached and adequately reinforced with 25 per cent. platinum solder.

When the crown has been completed in this manner, and in accordance also with the general requirements as previously described, the detail of procedure up to the final assemblage of all of the parts is the same as indicated for dowel crowns in the preceding type of construction, but, in the adjustment of the connecting bar it should be observed that strength is insured by the increased contact which should obtain between it and the band of the telescope crown.

This may be accomplished in fitting the bar by flattening one end of the iridio-platinum wire on the anvil and then bending it to conform closely to the lingual surface of the crown, thereby obtaining a maximum degree of strength in its attachment when soldered. (Fig. 353.)

Additional reinforcement of the cusps may also be obtained by fusing a layer of porcelain in them, from the inner side, when baking the piece, and if the color of the crown is not pleasing to the patient, such a fastidious objection may be overcome by heavily gold-plating the finished piece.

The elimination of any possible objections which may be raised with regard to the color of platinum, together with the facts that gold is doubtless more pleasing to the eye; that *plating* is only temporary, and that the use of the telescope crown upon such teeth as are somewhat removed from the range of vision, is advantageous, makes the combination of porcelain and gold in the construction of bridgework highly artistic and therefore often eminently desirable. Indeed, by combining the two

the possibilities of porcelain work are enhanced; the application of more extensive pieces is made practicable and the most esthetically ideal type of construction is achieved.

This combination may be easily effected by constructing such portions of the piece as must go through the furnace on a platinum substructure and in accordance with the requirements indicated, and then subsequently attaching the gold parts with solder after the porcelain piece has been entirely completed, and this procedure may be easily accomplished by simply making some provision for the attachment of the solder in the final assemblage, and entirely without danger of fracturing any part of the porcelain.

Gold Crowns as Posterior Abutment Pieces.

Thus when it is desirable to use a gold crown as the posterior abutment piece instead of one made of platinum, the procedure, as indicated, is identical up to the point of investing the case for the final assemblage of all of the parts, except that the saddle is previously attached only to the platinum cap for the dowel crown, at the anterior end, and that the gold crown is thus allowed to remain free and *in situ* upon the model during the completion of the porcelain part.

The platinum substructure, together with the facings which are to form the porcelain part of the piece, are then removed, invested and soldered as indicated, but at this time some provision must be made for the presentation of a well reinforced surface of platinum toward the gold crown, which will admit of subsequently attaching the latter thereto with gold solder. This may be effected by boxing up the posterior end of the piece with not thinner than 28 gauge platinum, and securely soldering it to the saddle, connecting bar and lingual support as illustrated in Fig. 354 A.

When thus completed the porcelain may then be built up, carved and baked, as desired, and when this part of the piece has been entirely finished it should be replaced upon the model, attached in its proper relation to the gold crown, with hard wax, and the whole then carefully removed, invested and soldered with 18-karat solder.

As the space between the porcelain part of the piece and the gold crown, which is to be filled with solder, is necessarily small (Fig. 354 B), the soldering may be facilitated by allowing the latter to be more or less freely exposed in the investment, and all danger of fracturing the porcelain, or of encountering any difficulties in the procedure will be overcome by slowly and thoroughly heating the case before attempting to fuse the solder. The result obtained in the completed case is shown in Fig. 354 C.

Dowel Crowns as Abutment Pieces.

Because of the desirability of using some form of porcelain crown as abutment pieces on all of the ten anterior teeth, and of the usual difficulty in observing such cosmetic requirements, which apply particularly to the construction of *bicuspid* crowns, the typical form of porcelain crown, supplemented by provision for admitting of attachment with solder, will be found most artistic and practicable.

Such a provision may be made, and such crowns may be used in preference to gold ones, or even to gold ones with porcelain facings, with almost equal assurances of success and permanency by simply increasing the depth and thickness of the platinum extension upon the lingual edge of the cap, which has been previously recommended and illustrated in

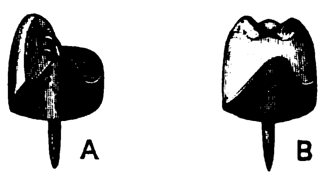


Fig. 355

connection with the construction of single bicuspid crowns, though the principle is also equally applicable to the construction of a crown for molars, cuspids, or incisors, or for any tooth where the use of porcelain may be regarded as safe, and where it may be desirable to avoid the presence of gold cusps or backings for cosmetic reasons.

When it seems warrantable to use such a crown as an abutment piece the entire cap should be made of not thinner than 28 ga. platinum, and the lingual extension, which is added at the time of soldering the facing, should be of at least the same thickness, and as wide or deep on the approximal side, presenting toward the dummy or dummies which are to be subsequently attached, as the occlusion will admit. (Fig. 355 A.)

If this extension is well reinforced with platinum solder, when the crown is then baked and completed, ample strength and opportunity for attachment with solder is thereby afforded, and a most artistic abutment piece is made possible. (Fig. 355 B.)

When thus completed it should be placed in position in the mouth together with the other abutment pieces, and the "bite" and impression secured, when the bridge may be assembled and soldered as usual.

All Porcelain Dummies.

Most of the advantages to be obtained in porcelain bridgework together with the elimination of the *necessity* for a saddle, and the advantages offered by gold, may be achieved in a most practicable and highly esthetic manner with Brewster's bridge teeth, or similar types of porcelain dummies, in conjunction with the above style of crown for the anterior abutment pieces, and gold telescope crowns for posterior attachments, and it is safe to say that this combination affords a type of construction which is more generally applicable than almost any other, and which offers opportunity for obtaining the very acme of artistic and mechanical achievement in the line of bridge construction.

Fig. 356 shows a typical case of this kind; two other cases, in one of which a porcelain crown on the *cuspid* serves as the anterior anchorage, were previously illustrated in connection with the detail incident to the use of this class of porcelain "dummies" in Fig. 321.

Fig. 356.

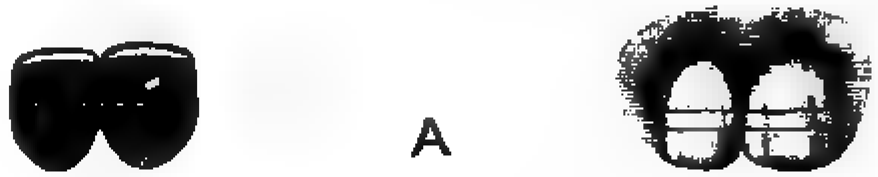
Making Porcelain Blocks.

Because of the difficulty of obtaining ready-made gum blocks which may be suitable to the requirements and variations so frequently demanded by the extent of absorption and the type of tooth, and which may even then be successfully attached to any form of abutment pieces for "fixed" bridges by means of soldering, the construction by the dentist of special pieces which will meet the combined requirements is not infrequently desirable.

This may be accomplished with comparative ease by first obtaining good models with the caps or abutment pieces in position, and then selecting suitable long-pin facings for the entire case. In anterior cases where no saddle is required these should be ground to the desired adjustment

and the separate crowns then completed, after which the intermediate facings which are to constitute the desired block should be assembled with hard wax, removed from the model, and invested. They should now be united by means of a connecting bar of about 16 g. round iridio-platinum wire, placed immediately beneath the pins, and attached with 25 per cent. platinum solder, and at the same time provision for subsequently soldering the finished piece to the other part of the bridge should be made by attaching a small piece of 28 g. platinum plate to each end of the connecting bar. (Fig. 357 A.)

When thus assembled the piece may then be finished with porcelain and the required adaptation and conformation obtained by burnishing



A

E

Fig. 357.

platinum foil over the surface of the model, and building the porcelain down to it. When completed, the platinum foil may be stripped off and the piece then placed in position on the model, removed in its proper relation to the attachments, invested and soldered with 18 K. solder. (Fig. 357 B.)

The same procedure applies also to the construction of blocks where the use of a saddle may be indicated by the requirements of occlusion or extensive restoration. In building such blocks, however, the saddle should be adapted in the prescribed manner and then attached to the facings at the time of their assemblage with solder. Fig. 358 illustrates the typical application of a section constructed in this manner.

Building, Carving and Baking.

Whilst the details incident to the manipulation and fusing of porcelain have been elsewhere considered at some length, their application to the construction of bridgework in particular requires special emphasis.

As soon as the metal substructure has been removed from the investment after the final soldering, it should be treated to the acid bath and allowed to remain therein long enough to insure the thorough removal of all particles of flux, investment material, etc., and then washed in warm water to remove the acid.

Fig. 358.

All sharp edges of metal, and projecting ends of pins throughout the piece should now be finished down with small carborundum stones, used in the engine, and then with disks, until *smooth* and *nicely rounded,* when the metal substructure is ready for the porcelain. Failure to observe this detail will be apt to result in unnecessarily diminishing the strength of the finished piece, or in the appearance of small checks in the porcelain near its junction with the substructure, both of which may be attributed to the presence of sharp angles or edges of metal.

Building Body. When thus finished and again washed thoroughly in order to remove debris, the piece should be grasped in a small pin-vise and the porcelain body, mixed with distilled water to as thick a consistency as it may be used, and thoroughly *spatulated,* then applied and carefully worked down into the most minute crevice. To obtain the maximum of strength in the fused porcelain the "body" should be *packed* as thoroughly as possible and air spaces must be avoided. As this procedure is continued and the piece is gradually built up to the desired form, the surplus moisture may from time to time be removed with a small piece of linen or blotting paper held between the thumb and finger, some degree of pressure being used.

When ample proportions to admit of shaping to the required conformation obtain, the mass may then be passed over a flame, or held near the heated furnace for a few moments until dry enough to admit of carving nicely without crumbling.

Carving. With a suitable instrument, such as has been previously illustrated in the chapter on Porcelain Crowns, the "body" should now be given definite form, and carved until each tooth is more or less distinctly shaped, and until the desired occlusion and general outline for the finished piece is obtained.

This may be observed by carefully removing the piece from the pin-vise and placing it upon the model, on the articulator, and in the event of the "body" becoming too dry to be handled it may be slightly moistened with water by means of a small brush.

When the piece has been suitably carved it should then be noted that *no thin frail edges* of porcelain *overlap upon the metal,* as such parts will invariably fracture in cooling, or be broken off either before, during or soon after mounting, and it should also be noted that the interior of the abutment pieces and the under-surfaces of saddles are clean and free from particles of porcelain, which, after fusing, might interfere with the subsequent adjustment of the piece.

While it is desirable to use but one grade of "body" throughout the piece, for the reasons previously mentioned, a more artistic result is usually to be obtained by selecting a darker color for the first bake, and then finishing with a color which closely matches that of the facings, thus obtaining a blend of the two which results in a darker effect toward the base and down in the grooves and pits of the finished piece.

Baking. When the piece is thus ready for the first bake it should be adjusted to some form of fire-clay support which will cause it to maintain a perpendicular

position and securely support it, and then placed in front of the slightly heated muffle where it should be allowed to remain until thoroughly dry.

In placing the piece in the furnace it must be observed that it is free from contact with the walls of the muffle, as too close proximity thereto frequently results in burning the color out of the facings, and direct contact would be likely to fracture them.

It should also be noted that the piece is placed *crosswise* in the muffle in order that a uniform heat may obtain throughout, as this varies appreciably in all open-end furnaces, and uniformity is imperative. And further it is usually best to allow the porcelain part of the piece to present toward the door of the muffle as by this means the fusing of the "body" may be observed during the process.

The muffle should then be closed and the temperature gradually increased until fusing begins, but for the first bake the body should only be fused to a high *"biscuit,"* or until a close coalescence of the particles has taken place. This will leave the surface somewhat granular, but insures a degree of shrinkage which is most favorable both to strength, and to the completion of the piece in two bakings.

When the baking is thus completed the heat should be *immediately* shut off, and the case then allowed to remain in the muffle until cool enough to remove therefrom without danger of checking the facings.

When sufficiently cool to admit of handling, the piece should then be removed and again adjusted to the pin-vise. Distilled water, applied with a small brush, should now be carefully worked down into all crevices and spaces presenting as a result of the shrinkage, as a means of assisting in carrying the body well down into places which might otherwise be difficult to completely fill.

Well mixed "body" of the proper color and consistency should now be applied with the point of the carving instrument and carefully worked down into all such spaces by jolting with the serrated edge, and when these are well filled the surplus moisture should be absorbed, and the full outline, contour and occlusion restored, when the piece is ready for the second bake.

If the first bake was carried to the point of shrinkage and vitrification indicated, and the body was closely packed, two bakes will usually be all that is required to complete the case, but the second bake should, of course, be carried to the point of complete vitrification, and be heated, and allowed to cool, in the same manner.

In cases where gum restoration demands the presence of pink enamel, that may be used at this time also provided its fusing point is approximately the same as that of the basal body, but if it should be of

the low fusing variety, and a higher fusing body used for the base, a third or separate baking will, of course, be necessary.

In the event of imperfections after the second bake, a third, or possibly even a fourth, bake may be required, and in such instances the lower fusing enamels can be used to advantage whenever the proper color may be obtained.

If the body has been each time closely packed, and at no time overfused, any grinding which may be demanded by the desired adjustment can be done with impunity, but such surfaces should afterward be highly polished with fine disks.

Finishing.

For the reason that so little metal is exposed, the finishing of porcelain bridgework is usually a very simple procedure, and yet even though beyond the range of vision all the surfaces of platinum which are not covered by porcelain should be well finished with stones and disks, and then highly polished on the lathe in the usual manner, in order that the work may possess every possible artistic and hygienic property.

A more *finished* appearance may then be obtained by gold-plating, and such a procedure is particularly indicated in cases where the platinum may be exposed to view, and also where both gold and porcelain are combined in one piece.

Repairing.

The repair of porcelain bridgework is usually attended with many difficulties, the principal one being the removal of the piece when mounted with cement. As this becomes imperative, however, it must be effected irrespective of the mounting medium, and therefore when cement has been used, some further mutilation of the piece must be expected, and is usually unavoidable. To encounter these difficul-

Fig. 359.

ties, however, will serve as an object lesson and show why porcelain bridges in general and dowel crowns in particular, should never be mounted with cement alone. In the removal, if telescope crowns are present, their attachment to the roots should be destroyed first, and this can usually be accomplished in the most expedient manner by the method illustrated in Fig. 114. The detachment of dowel crowns is, of course, more difficult, but these may usually be loosened by protecting the porcelain with pads of cotton in the form of rolls, grasping the piece with heavy pliers or forceps, and then gradually working it until the attachment of each abutment piece is broken, or, a very ingenious and most useful instrument adapted to this particular purpose, designed by Dr. C. G. Morrell, of Chicago, and illustrated in Fig. 359, may be used by hooking the beak over the edge of the band, and then pounding against the other end with the cylindrical weight.

After removing, all remaining particles of cement, gutta-percha, etc., should first be cut away with burs and the case then placed in the acid bath. This should be followed by washing it thoroughly in tepid water in which has been dissolved a liberal quantity of sodium bicarbonate, after which it should be allowed to dry thoroughly.

The remaining accumulations of organic products must then be removed before any effort to effect repair is attempted, and this may be accomplished by placing the piece in the furnace, before heating the muffle, and then turning on the heat *very slowly* at first, until, by gradually and carefully increasing it to a low red heat, all organic matter may be burned out.

As a means of preventing too rapid heating, and the possibility of fracturing the facings, or otherwise injuring the case, it may be entirely submerged in an investment, compounded largely of asbestos, previous to placing it in the furnace, and then subjected to the same degree of heat in the same manner. While a safe precaution, this is unnecessary, however, in small pieces or single crowns.

After this procedure has been observed, repairs may then be effected in the ordinary manner and without subsequent danger.

Removable Bridgework.

CHAPTER XXVI.

Advantages, Attachments. Clasps: Clasps Adjusted to Gold Crowns, Typical Application of Clasps, Clasps Applied to Porcelain Work, The Bryant Clasp Attachment, Peeso's Methods, Tube and Split-Post Attachment, Crown and Split-Post, Interlocking Occlusal Rest.

As designated in the chapter on Classification, etc., "removable" bridgework embraces that type of construction wherein the piece which supports the missing teeth is sustained in position by contact between it and the contiguous soft tissue, supplemented by some form of mechanical attachment to remaining natural teeth which will afford a means of temporary fixation and stability, and yet admit of the ready removal and replacement of the piece without disturbing the integrity of any of its parts.

Since the principal objection to the employment of "fixed" bridgework lies in the unsanitary condition, which, to a greater or less extent, usually presents as a result of the application of permanently anchored pieces, and of the inaccessibility of some of their surfaces; and since the importance of *oral hygiene* is now so fully recognized, any methods of procedure which will promote this, will always occupy a more or less unlimited sphere of usefulness, and be welcomed alike by the conscientious, progressive operator and the appreciative and cultured patient.

Advantages. Compared with "fixed" bridgework it is therefore obvious that this type of construction offers several features of advantage, and these may be classified as follows: *First,* and most important, the hygienic properties to be derived from opportunity to remove and cleanse the piece. *Second,* adaptability to varying conditions of absorption, occlusion and support, which affords a greater range of application. *Third,* opportunity for restoring lost tissue in cases of extensive absorption, thus making pos-

sible more natural and more artistic results. *Fourth,* because of the support derived from contact with the soft tissues, fewer abutment teeth are mechanically required. *Fifth,* unless crowns are used less mutilation of the supporting teeth is generally involved or demanded. *Sixth,* a greater longevity of those so employed is usually insured by the maintenance, to a greater extent, of their natural mobility.

Indications. From a careful analysis of these advantages it would seem that the indications for the selection of this type of construction must be more or less general, and that its application would in turn be quite universal. While this is true to a large extent, still "removable" bridgework will perhaps never entirely supersede "fixed" structures, and though doubtless more generally applicable, there will nevertheless be opportunities for the successful utilization of each type in its proper place, and the selection of the one best adapted will be largely a matter of judgment and discrimination.

As a general rule, however, it is safe to conclude that "removable" structures are indicated in those cases where the conditions and requirements are *unfavorable* to the reliance upon "fixed" pieces.

Specifically this would confine the application to two general classes of cases; *first,* to those which demand the replacing of several teeth, and the restoration of considerable lost tissue; and, *second,* to those cases where the *number, position in the arch,* and strength of the remaining natural teeth are unfavorable to the mechanical demands of a "fixed" structure.

The former class would thus include *extensive* bridges, or those demanding the use of a "saddle" of such proportions as to admit of the required restoration, and at the same time demand removal as a means of sanitation; while the latter class would include those cases in which the utility of the remaining natural teeth is questionable, or is inadequate to the mechanical requirements because of looseness, or of being too far apart or otherwise unfavorably located in the arch, and where some form of support by means of contact with the intervening soft tissue is therefore required.

Requirements. Incident to the application and construction of removable bridges the requirements demand, first, a close adaptation of the body of the piece to the soft tissue upon which it is to rest; and, second, a means of *attachment* to the supporting teeth which will admit of easy adjustment in removing and replacing the piece; afford a reasonable degree of stability and durability, and yet permit some slight mobility when in position in the mouth; and which will further possess sufficient inherent strength to insure reasonable permanency.

Attachments.

Thus like "fixed" bridgework it is apparent that the successful application and general utility of "removable" structures is also largely a problem of anchorage, or *attachment* to the supporting teeth.

This problem has engaged the attention of the profession for a number of years, and as a result innumerable methods of attachment to the remaining natural teeth, which would be an improvement upon the more simple and ordinary form of clasps, have been devised.

Many of these have been proclaimed a dental desideratum, and have been heralded to the profession as a means of revolutionizing the construction of all forms of partial dentures, only to be subsequently abandoned, as impracticable, because of being entirely too intricate, or as worthless, because of a lack of strength.

Clasps.

Some form of clasps, however, when properly adapted, is still to be regarded as the most simple attachment, and while its indiscriminate employment or its faulty adaptation may frequently prove injurious to the supporting tooth, or may sometimes even cause its loss, the fault lies more often with the operator than with the principle.

Requirements. In the adaptation of simple clasps to the crowns of natural teeth an observation of the following requirements will increase the opportunities for obtaining successful results.

First. Where several natural teeth remain, in determining which ones to clasp, those should be selected which are of the most favorable shape, stability and position in the arch, and with approximately parallel axes, and as nearly opposite in their relation to each other as possible. Extensive experience has shown that the bicuspids offer the most favorable shape for the adaptation of clasps; that the molars rank next in order, and that the cuspids and incisors, respectively, are least favorable. Indeed, *clasps upon any of the six anterior teeth are rarely ever indicated,* and seldom practicable.

Second. The clasp should always be made of an alloy especially prepared for this purpose because of the necessity for a degree of springiness, or resiliency, which will admit of some expansion and yet offer sufficient resistance to return to its original form, and to thus insure a firm grasp upon the tooth. (See chapter on Metals and Alloys.)

Third. It should be heavy or thick enough to more or less permanently retain its form, for which reason nothing thinner than from 26 to 28 gauge should be used.

Fourth. In adapting it to the tooth the clasp should be as *wide* as possible, *not to interfere with the occlusion* or *impinge upon the gum tissue* (Fig. 360 A), and it should encircle at least three angles of the tooth's circumference. (Fig. 360 B.)

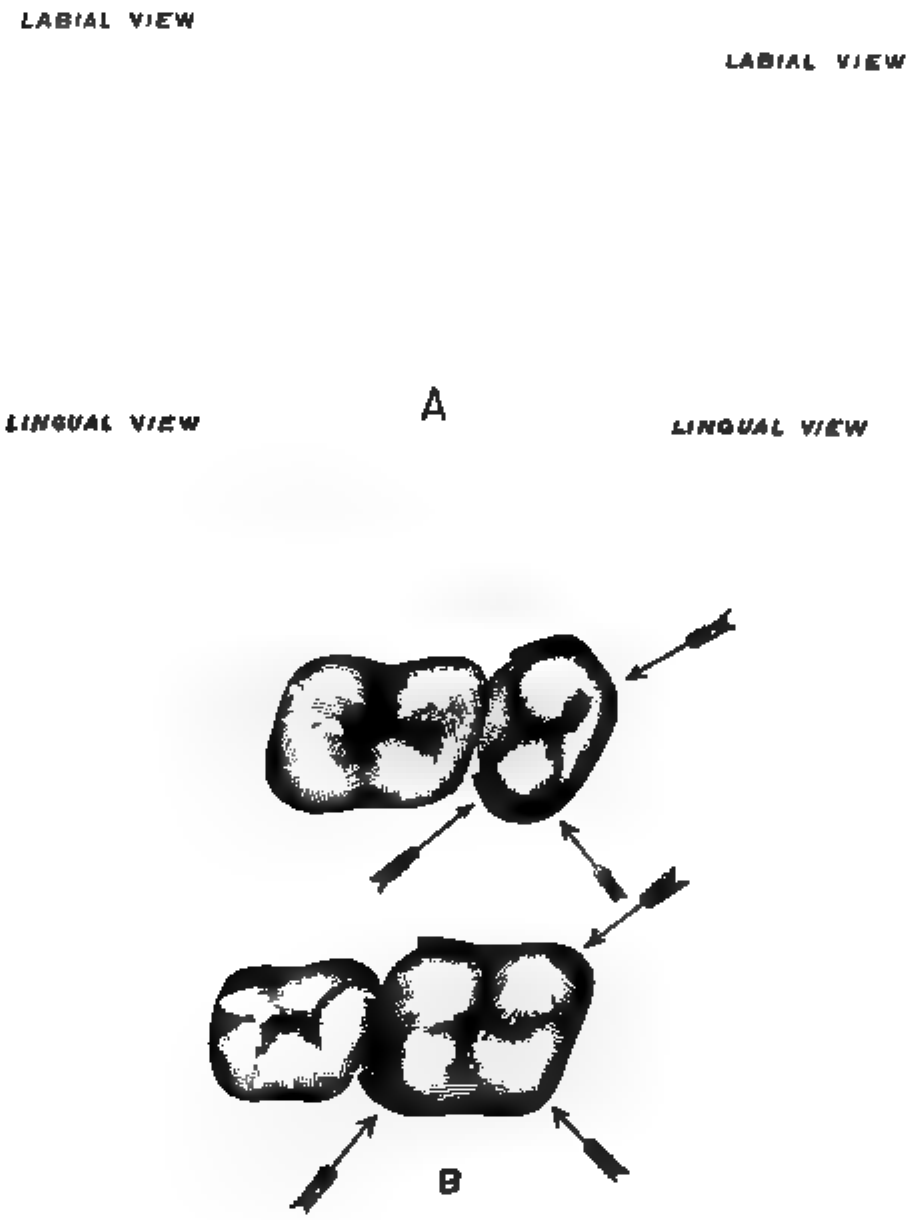


Fig. 360.

A wide clasp is preferable to a narrow one, for the reason that it will thus encompass the most bulbous portion of the tooth, and be sustained in its relation thereto by *frictional contact* at a few points.

Such a contact is desirable and advantageous because the possibilities of mechanical abrasion and ultimate disintegration of the enamel therefrom, or from chemical dissolution, as compared with a narrow clasp which is necessarily more closely adapted to the walls of the tooth, are thereby diminished; and it is necessary that it should encircle at least *three angles* in order that both ends may grasp the tooth in such manner as to sustain it in position thereon.

Fifth. In effecting this adaptation a plaster impression of the crown of the particular tooth to be clasped (Fig. 361-A) should first be obtained and then properly built up, so as to allow the pouring of a *fusible*

b

a

Fig. 361.

alloy model, showing just the teeth to be clasped. (Fig. 361-B.) The clasp should then be primarily formed and trimmed to the proper outline on the model, which may be done with ease because of its indestructibility. It should then be placed in position on the natural tooth and the adaptation perfected in the mouth, after which the final impression for the attachment of the clasp, or clasps, to the base should be taken with them in position. The most accurate method is to take a separate impression for each clasp, attaching them to the base one at a time.

Sixth. If the attachment is to be made to a metal base by soldering, the impression, with the base and clasps in position, should be filled with a small quantity of *investment material*, so that when separated the soldering may be done directly on the model, thus insuring the preservation of the proper relation.

When the case is to be of vulcanite, however, the impression should be filled with *plaster*, and when the model is obtained the clasps may be carefully detached therefrom, and anchorage pins, or projections, then

soldered to them at the proper points, after which they should be replaced on the model (Fig. 362) and the case finished as usual.

Seventh. In the attachment of the clasp to the base whether it be done by direct soldering thereto, as in the case of gold or platinum bases, or by the addition of pins, or projections for attachment to vulcanite, it must be observed that no interference with the *spring* of the clasp is

Fig. 362.

offered in either instance, and that each end is allowed to remain *free* from any contact or attachment which would impair its grasp of the tooth, and thus destroy its effectiveness as a *clasp.*

It is also necessary to observe that the attachment, or provision for attachment, be made at a point approximating a nearly perpendicular surface of the crown of the tooth supporting it, or, in other words, at a point where *no spring in the clasp will be required* in adjusting the piece to position.

Also it must be further observed that adequate strength in the attachment of the clasp to the base be insured. This is a very important feature, as clasps are subjected to considerable stress, when in use, as well as when the piece is being removed or replaced, and it is therefore necessary to make every provision for obtaining the highest possible degree of strength in the attachment.

Injurious Effects. While the use of narrow clasps, made of ordinary clasp metal, or in the form of small round wire doubled upon itself, or of half-round wire with the flat side adapted to the tooth is sometimes recommended, any form of narrow clasp, such as is illustrated in Fig. 363, when adapted to the natural tooth, is usually to be condemned for the reason that the narrower

Fig. 363.

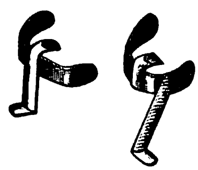


Fig. 364.

it is the closer it fits, or hugs, the tooth; and the closer it fits the tooth the more mechanical abrasion it causes; and the more abrasion it causes the more injury it does.

For the same reason the practice of first making the clasp of pure gold well adapted to the tooth, and then fitting clasp-metal over this and attaching the two with solder, is to be discouraged, particularly when the application is to be made to the natural crown.

Indeed, when simple clasps are to be used, and when they are to be supported by the natural crown of the tooth, those made in accordance with the above requirements, and sustained by frictional contact at a few points only, will be found to serve the purpose better, and to do less injury to the tooth than any of the latter forms.

Injury to the gum tissue surrounding the necks of all of the remaining natural teeth is also quite common in cases where simple removable appliances in the form of either "bridges" or "partial plates" which rest entirely upon the gum are worn. As a result of the continued irritation caused by the constant riding of the piece upon the necks of these remaining teeth, considerable gingival inflammation is usually present, and in

many instances this becomes so severe as to result in the ultimate loosening, or, possibly, in the loss of the teeth.

Such a casualty may be more or less entirely overcome, however, and any great extent of subsequent settlement precluded, by providing a rest which will cause the piece to ride largely upon the supporting teeth instead of on the gum tissue.

The Bonwill Clasp.

As a means of overcoming this possibility, and of also diminishing the devastating influence of abrasion resulting from the adaptation of the usual form of clasps, and of further obtaining increased stability in their attachment to the tooth, an occlusal rest constituting a part of the clasp was early advocated by Dr. W. G. A. Bonwill. (Fig. 364.)

Fig. 365.

This type of clasp is still frequently used, often indicated and usually productive of good results. In constructing such clasps the occlusal rest should be made of a sufficiently strong material—plate or half-round wire—bent to the proper form, and subsequently attached to the clasp by means of solder, and the end should rest in and conform to the sulcus of the tooth so as not to interfere with the occlusion of the opposing teeth.

Clasps with Occlusal Rests in Fillings.

Greater strength and a more secure fixation of the piece when in position may be obtained by inserting a filling and allowing the projecting end of the occlusal rest, which should be similarly attached to and thus become a part of the clasp, to fit snugly into a socket cut for its accommodation into the body of the filling as previously described and illustrated in connection with simple rests for "fixed" bridges in Fig. 261.

Indeed, whenever it may possibly be applied, this method of forming a clasp attachment for "*removable*" bridges, and particularly the procedure suggested by Dr. Ottolengui, which has been fully described, is to be regarded as among the most useful and highly practicable of all similar processes. (Fig. 365.) When *two* are employed on the same fixture, however, absolute parallelism must of course obtain.

Clasps Adjusted to Gold Crown.

Because of the injury to the natural crown of a tooth supporting a clasp which usually occurs to a greater or less extent in time, and as a result of abrasion and chemical dissolution, it may often be desirable to first place a gold crown upon the tooth, and then adjust the clasp to it, for by this means the possibility of subsequent disintegration of the natural crown is entirely eliminated; a perfect adaptation and a more secure mechanical adjustment is made possible and greater permanency is insured.

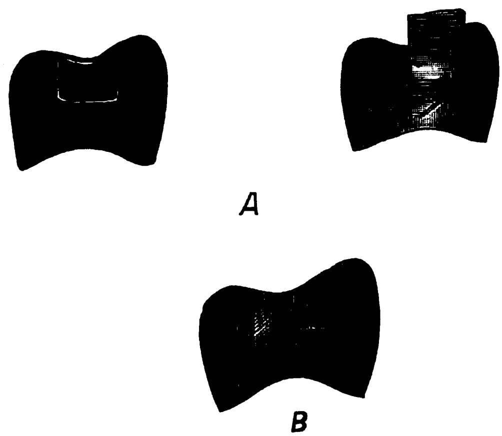


Fig. 366.

In the construction of a crown which is to be used for this purpose, however, two features should be observed. First, it should be made heavy enough to withstand the continued friction from contact with the clasp, and second, no great degree of lateral contour should be given to its form.

In observing the first, a form of gold—such as *platinized gold* which is somewhat harder or tougher than the ordinary plate should be used for the band, and it should be at least 28 ga. in thickness. The second requirement should obtain in order to admit of a close telescoping adjustment of the clasp to the crown, and to facilitate the removal and replacement of the piece, both of which would be more or less impaired if much contour prevailed.

In adjusting the clasp to the crown it should be adapted in accordance with the preliminary requirements in so far as size, form and relation are concerned, and if simple clasps are used this may be done after mounting the crown, or crowns.

Clasps with Occlusal Rests Applied to Gold Crowns.

An occlusal rest is also equally applicable to gold crowns, and will add much to the stability of the piece. This may be obtained in the most simple manner by following the procedure described in connection with the Bonwill Clasp.

Or, if still greater stability is desired a socket for the reception of an interlocking rest may be made in the crown, and the rest adapted and adjusted to this as suggested in its application to fillings, and then attached to the clasp.

In this procedure the socket in the crown should be made after the cusps have been *attached* but *before* they are *reinforced.* This may be easily accomplished by cutting into the crown at the proper point and to the desired dimensions; fitting an "L" shaped piece of gold into this, thus forming a box (Fig. 366-A), and then completing the soldering and reinforcement of the cusps (Fig. 366-B), after which the rest should be accurately fitted therein, and then soldered in its proper relation to the clasp, when the crown may be mounted, and the impression subsequently taken with the finished clasp or clasps in position, as indicated.

Typical Application of Clasps.

While clasps are more or less generally applicable to a large variety of conditions, and particularly to the support of all forms of partial dentures where natural posterior teeth remain on both sides of the arch, there are nevertheless certain cases where they are especially useful.

Lower Cases.

A type of cases which is quite common and which will serve to illustrate one of the most practicable applications of clasps, irrespective of whether they are adapted to the natural crowns of teeth, or to gold crowns, is where the replacement of the *lower bicuspids and molars* is demanded.

This condition, while more or less simple, is encountered so often as to require the very best type of construction, and this is usually to be accomplished by first making the clasps and then taking the impression with them in position on the teeth. When the model with the clasps in place is then obtained, a piece of 14 ga. round iridio-platinum wire should be conformed, by means of pliers, to the outline of the anterior part of the arch at a point well down toward the floor of the mouth.

When this adjustment is obtained the ends of the wire should be flattened on the anvil and then bent to conform to the requirements of attachment to the base.

If metal bases are used they should be swaged and fitted previous to taking the impression, and should be in position in the mouth—together with the clasps—when this is done. The impression should then be taken in the same manner as indicated for "saddles" in fixed bridgework.

The flattened ends of this heavy wire should now be bent to come in contact with the saddle and then waxed in place, removed, invested and soldered thereto. When this is accomplished a projection of the same wire, slightly flattened, or of heavy clasp metal should then be fitted to

Fig. 367.

extend from the wire to the clasps and securely sustained in position with hard wax. The whole should now be carefully detached from the model and invested and then soldered (Fig. 367), after which the teeth may be attached with vulcanite and the case then finished.

If the bases are to be made of vulcanite, or when aluminum is used, the procedure is the same except that the flattened ends of the wire should be adapted to the model in such manner as to admit of being subsequently well surrounded with rubber, and then notched with a file so as to insure mechanical retention and strength in the attachment, after which the clasps should be attached with solder in the manner indicated (Fig. 368), and the case then finished as usual. (Fig. 369.)

The employment of wire in this manner offers greater strength and less obstruction to the tongue; less irritation and consequent injury to

Fig. 368.

g. 369.

the gum tissue surrounding the remaining anterior teeth, thus increasing their durability, and insures a more absolutely hygienic condition than may be obtained in other methods.

Upper Cases.

By a similar mode of procedure these same advantageous features are frequently to be obtained in construction of upper cases involving the replacement of some of the posterior teeth, but where at least one remains on each side.

Fig. 370.

In such cases if the piece may be constructed of gold with vulcanite attachment for the teeth, or of platinum and porcelain, the covering of a very small portion of the palate will be required, and all contact with the necks of remaining natural teeth may be avoided (Fig. 371), while if vulcanite is used throughout, a greater area of the palate must of course be covered in order to insure sufficient strength, though contact with the necks of teeth may not be necessary. (Fig. 371.)

As applied to gold or platinum the base corresponding in size with that outlined, should be swaged of at least 28 ga. material, and fitted. The narrow connecting transverse portion which extends across the palate should be well reinforced by soldering thereto an additional piece of the same gauge, but somewhat narrower, also swaged between the same dies.

This insures adequate strength in the base and when thus reinforced, the clasps should be fitted, the impression taken and their attachment then secured in the manner indicated, after which the case may be completed by attaching the teeth.

While the illustration shows the clasps adapted to the bicuspids, in similar cases they may be placed upon the molars. Indeed this would usually be preferable provided the shape and vertical pose of the molars were favorable.

Fig. 371.

Clasps Applied to Porcelain Work.

Any of the various forms of clasp-attachments may be successfully applied to porcelain work in one or the other of the following methods of procedure.

If the clasps are to be attached to the base, and thus become a part of the metal substructure, before subjecting the piece to the furnace, they should be made of iridio-platinum and soldered with 25 per cent. platinum solder.

This is necessary in order that their attachment may not be disturbed during the fusing of the porcelain, and while the alloy of iridio-platinum is not very stiff nor springy after being annealed by passing through the furnace, still it may be used, and will answer the purpose better than any

other alloy which we have at present, capable of withstanding the necessary heat. It will, however, become harder and more springy as it is used, though perhaps never quite as resilient as clasp-metal.

Whenever it may seem best to employ the ordinary clasp-metal in the construction of clasps for porcelain work, this may be done by making a provision for subsequent attachment in building the platinum substructure, in a manner similar to that advocated in making *gum blocks,* and then attaching them to the piece with 18 Ka. solder, *after the baking of the porcelain.* This may be done without danger of fracturing any part of the porcelain if the case is properly invested and then slowly but thoroughly heated.

In both of the preceding methods, if preferable, any of the various other forms of attachment to the supporting teeth—which will be subsequently considered—may be used instead of clasps, but, by whatever means the attachment may be secured, this general type of construction—as applied to supplying posterior teeth in both upper and lower arches—is unquestionably the most useful and practicable, wherever it may be employed.

The Bryant Method of Clasp Attachment.

A form of clasp-attachment for removable dentures, which has been devised by Dr. Emory A. Bryant, will be found useful in many positions where one or more natural roots may be utilized for carrying a gold crown, and a variation also permits of its application to dowel crowns.

Advantages. The advantage claimed for this method is rigidity of the fixture, which is held firmly against the gum, while lateral motion is likewise prevented. Unlike many other devices its usefulness does not materially decrease with wear, the clasp being made of platinized gold and therefore readily readjusted in case of slight loosening.

Indications. This form of clasp is indicated especially where bicuspids or molars are to be supplied, on one or both sides, and where there is at least one good bicuspid or molar root sufficiently strong to support a gold crown. Where the denture is to carry teeth on both sides of the arch, it is better of course if the Bryant clasp can be utilized on both sides of the mouth, but quite good results may be obtained with a Bryant clasp on one side, and an ordinary clasp on the other.

Briefly described this form of clasp attachment consists of a gold shell crown, to the sides of which is soldered an iridio-platinum wire,

(usually two are advisable), the crown being cemented to a natural root and serving as an abutment. The clasp is bent around the crown and adjusted so as to snugly telescope over the wire or wires, and then is securely affixed to the denture.

Technique of Construction.

The gold shell crown having been made and accurately adjusted to the root, and occlusion, is placed in the mouth, and with a sharp instrument a scratch is made along its buccal surface, parallel with the long axis of the teeth in the mouth which are in normal position. The crown is removed and this scratch is slightly accentuated by further scratching, when it will be found that a piece of iridio-platinum wire, 18 or 19 ga. will rest on this scratch without rolling off, the crown lying on

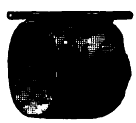


Fig. 372.

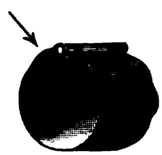


Fig. 373.

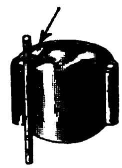


Fig. 374.

its side, in a little gully cut in the charcoal soldering block. The wire should be cut a trifle longer than the crown. (Fig. 372.) If the tiniest speck of 20 or 22 K. solder is dropped next to the wire, and the least bit of powdered flux sprinkled over the spot, the wire can be easily united to the crown without displacing it, by moving a brush flame over the whole till the solder flows. Powdered flux will be found better than liquid for this step of the work, as the boiling of the fluid is apt to displace the wire, and it is quite essential that the wire should be attached exactly along the mark. Next a little whiting and water is painted along the side of the wire which the end of the clasp is to engage, and when carefully dried will prevent solder from flowing on that side, the round surface of the wire on that side being thus preserved for the clutch of the clasp. When the whiting is dry, solder is banked up along the other side of the wire to form a surface flush with the crown. (Fig. 373.) Two methods of forming the clasp may now be followed. Where little spring to the clasp will be needed, clasp gold 28 ga. will be found easier to handle, and after it is properly shaped may be stiffened by flowing solder over its surface. In many cases, however, it is better to use 26 ga. even though it may be necessary to make the extreme ends of the clasp thinner by filing, or by hammering on an anvil with a light hammer. Whichever gauge is used the end of the clasp is first bent so as to fit over the wire

and then is made to follow around the crown at least two-thirds of its circumference; farther if possible. Then the clasp is cut off of proper length to allow for turning the end at that point, which is to engage the second wire. Usually, if properly made the clasp will now hug the crown tightly, and the second wire may be slipped in between the clasp and crown. This is likewise cut off a little too long. The clasp is then removed and lightly coated with whiting on its inner surface; then replaced on the crown, and the second wire slipped in. This time it is set on the block with the occlusal surface up, and a speck of solder is dropped between the crown and the projecting end of the wire. (Fig. 374.) The brush flame of the blowpipe will tack the wire and crown together with little or no danger of uniting with the clasp, which may then be removed, and the wire more firmly soldered as was the first one. Fig. 375 shows the crown and clasp complete.

Fig. 375.

The crown may then be placed in the mouth with clasp in place, and the fixture to which it is to be attached held against the roof of the mouth firmly with one finger while an impression is taken in plaster of Paris. The fixture and the clasp are put in proper place in the impression, but the crown itself is omitted. A model is poured with a good investment compound, and the clasp united to the fixture either direct, or by a connecting bar, according to the exigencies. Where such abutment can be arranged on both sides of the mouth it becomes essential to observe that the telescoping wires are all parallel with one another. This may be accomplished by making a model from an impression taken with both abutment crowns in the mouth and then, by utilizing any of the many parallelling devices the scratches on the buccal surfaces of the two abutment crowns may be made parallel. Those on the lingual surfaces usually are made right by the clasp directing them to proper place. In cases where the teeth are badly tipped it may become necessary to reverse the order of the work; that is the wires may be placed on the lingual surfaces first in which case of course the paralleling device is used for making the marks on these surfaces.

Where it is desirable to arrange for an occlusal rest it may be accomplished in several ways. If the cusps of the crown be made solid, a square cavity may be cut therein and a lip of the clasp turned over to drop into this box. Such a lip should be reinforced with a piece of iridio-platinum wire and solder (Fig. 376). Figures 377 and 378 show a denture with this style of clasp.

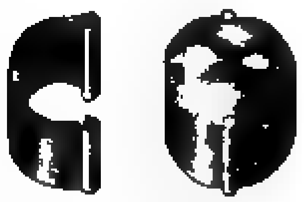


Fig. 376.

Fig. 377.

Fig. 378.

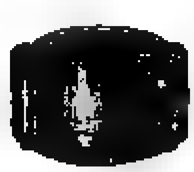


Fig. 379.

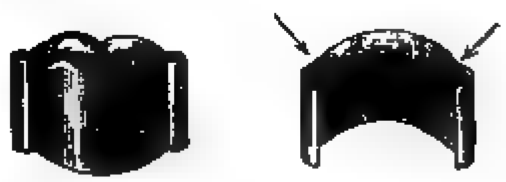


Fig. 380.

Fig. 381.

Dr. Ottolengui, who has used the Bryant Clasps extensively, especially in the construction of cleft palate carrying-plates, prefers either of the following methods. Sometimes he runs a piece of soft platinum wire along the surface of the shell crown close to the gum, attaching and stiffening the same with solder, and then the lower edge of the clasp is beveled to drop into the groove made by the upper edge of this wire. (Fig. 379.) In other cases, where the edge of the clasp will not irritate the

tongue or cheek he cuts the end of the telescope wires a little shorter than usual, squares them and then by soldering a tiny piece of clasp gold over the top of the clasp where it is bent to engage the wires, thus forms a boxing which, resting against the top of the telescoping wire, prevents the clasp from going further down. (Fig. 380.)

Where a cuspid or first bicuspid is to be utilized as an abutment the display of gold may be avoided by slightly varying the method. A dowel crown may be used, and grooves cut in the gold along the mesial and distal sides, and the ends of the clasp are then turned in so as to play in these grooves; this is somewhat similar to the arrangement in a staple crown, except that the fixture is removable. (Fig. 381.) Where an all porcelain crown is desired, the construction should include platinum sides, with the grooves already made, prior to adding the porcelain body.

Special Methods.

With the hope of improving upon the various forms of clasps, and of obtaining a means of fixation which would possibly be less injurious to the supporting teeth, and more secure and permanent, any number of special methods have been designed.

While many of these, among which may be mentioned a few such as those of Starr, Winder, Parr, Richmond, Curtis, Alexander, Rhein, etc., have served their purpose by at least aiding in the evolution of more practicable procedures, most of them have proven to be either too intricate, or too limited in their range of application, and have, therefore, been more or less abandoned.

For this reason no effort to describe any of them will be made, and hence only those which are used at the present time, and which are regarded as possessing some features of merit, some range of application, and some degree of usefulness, will be presented.

Peeso's Methods.

Among these the practical and ingenious methods of attachment extensively used by Dr. F. A. Peeso of Philadelphia, are particularly useful. These embrace three styles of attachments and an interlocking rest, and when selected and used judiciously cover a wide range.

Tube and "Split-Post" Attachment.

As applied to obtaining a removable anchorage adapted to the roots of teeth the type of attachment designated as the "tube and split-post"

crown is probably the most useful. This involves the construction of a telescoping dowel crown, part of which is permanently fixed to the supporting root, while the crown portion telescopes into and over it, and is removable.

Indications. While this form of attachment is applicable mainly to the anterior teeth, where a dowel crown would usually be indicated, the same principle may also be used upon the bicuspids, or any of the anterior teeth provided their size is favorable; but as considerable sacrificing of tooth structure is demanded it is more particularly applicable to the roots of upper cuspids and sometimes bicuspids and central incisors, or to those which are large enough to admit of the necessary preparation.

Technique of Construction.

The technique of construction involves the preparation of the root in the usual manner as for dowel crowns with a band, after which the *cap,* which is to be permanently anchored thereto, should be constructed as follows.

Cap and Tube. A band of about 30 gauge gold is fitted to the root, and carefully festooned to follow the cervical margin of the gum, after which it is removed and the end of the root is then cut down to a point just below the gum on the labial or buccal side, but leaving it about one-sixteenth of an inch above the gum margin on the lingual side. The band is now placed in position and marked around the inside, close to the edge of the root, with a sharp instrument. The canal is then enlarged to the size of the *tube* which is to be used, and the latter should be made of coin or 22 K. gold, or of platinum, about 34 ga. If a gold bridge is to be made, the bur or reamer should be leaned slightly toward the lingual side, thus sloping the enlarged canal in that direction, so that when the tube passes through the floor there will be ample room on the labial or buccal side for the facing. If there is sufficient space, however, to admit of using a porcelain bridge, this is unnecessary. The tube, after soldering the seam, and closing the apical end with a small piece of plate, is then rounded on this end and fitted to the canal, and a plaster impression, just large enough to sustain the relation of the band and tube, is taken.

A small model is then made, the inside of the band and the outside of the tube having first been given a very thin coating of wax to facilitate their removal therefrom. The band is now cut off to the line indicated by the scratching, and then trimmed flush with the end of the root, filed so that it is perfectly flat, and a floor of 28 gauge gold soldered to it. A

hole is next made in the floor and the tube waxed and soldered the same as the dowel would be in the ordinary cap, after which the open surplus end extending above the floor is cut off and the cap finished and polished. (Fig. 382.)

Crown and "Split-Post"

The removable part of the attachment is made as follows: The "post," of half-round iridio-platinum, or platinized gold wire, is bent double upon itself, the ends just caught with a little pure or coin gold,

Fig. 382.

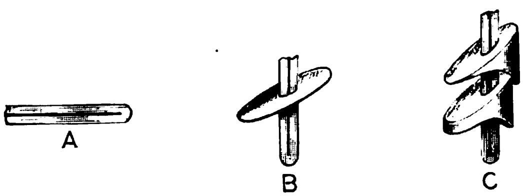


Fig. 383.

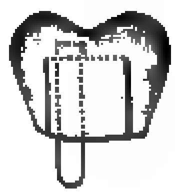
and then filed or turned to exactly fit the tube in the cap. (Fig. 383-A.) A floor of 28 gauge gold, or of iridio-platinum, if the piece is to be of porcelain, is then drilled so that the "post" will fit tightly, and waxed in place, removed, invested and soldered. (Fig. 383-B.) After cleaning in acid, it is replaced on the lower cap, trimmed even with the sides all around and a half band of 28 gauge gold or iridio-platinum fitted to the lingual side, reaching only to the gum line, and toward the buccal side to a point about where the facing will reach, when it is waxed, removed and soldered. (Fig. 383-C.) The inner cap is then placed on the root and, with the other attachment also in place, the bite and impression should be taken, the facings selected and the bridge then completed in the usual manner.

Molar Attachments.

As applied to molar teeth two forms of attachment are employed, one involving a combination of a telescoping gold crown and a tube and "split-post," and the other an inlay in conjunction with the same means of anchorage

Telescoping Crown and "Split-Post.

In the construction of the style of attachment which involves a gold telescope crown and a "split-post," the tooth is devitalized and prepared as for a full gold crown, the occlusal surface being cut short enough to allow for good thick cusps. A band is then made so that its sides are exactly parallel, or very slightly larger at the *neck,* and fitted to conform closely to the tooth, passing about one-sixteenth of an inch below the gum, and



a *b* *c*

Fig. 384.

then marked around the inside even with the top or occlusal end of the root. A tube of suitable size is used, resting it on the *floor* of the pulp chamber, or if this is very shallow one of the canals may be enlarged for a little distance, and the tube adjusted in place so that it is exactly parallel with the sides of the band. (Fig. 384-A.) An impression is now taken to preserve their proper relation, the *band* and *tube* waxed in the same manner as described in the former attachment, and the model made from hard plaster. After it has been separated, the band and tube are heated slightly and removed. The band is then cut off even with the occlusal surface of the root, as previously marked on the inside, filed perfectly flat and a floor of 28 ga. gold *sweated,* or soldered to it with a minute quantity of solder, after which the tube is fitted and soldered and the cap finished the same as in the case of the former method. The whole inside of the band is now given a *very thin* coating of wax and then filled with *fusible* metal. The outer band is made a little small and driven

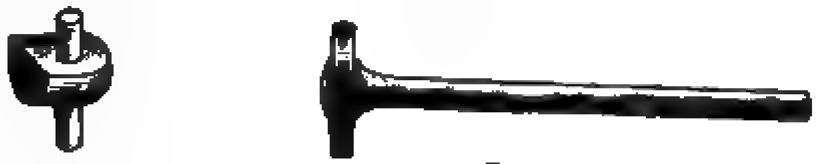
over the reinforced inner cap to within about one-sixteenth of an inch of its lower, or cervical, edge, so that it will only reach to the gum line and not go below it. (Fig. 384-B.) It is then cut off and filed flush with the inner cap and the floor sweated or soldered to it. Cusps and suitable contour to meet the requirements of occlusion, contact, and alignment are now added to this, and the split pin at the same time soldered in place, letting it extend a little above the floor so that it may be firmly attached to the cusps. After the cusps have been made or selected, they are made solid and the under surface filed perfectly flat and soldered to the cap, a hole having first been drilled through to receive the head of the "split-post." The contouring of the sides may then be done with a high karat solder and after it is finished and polished, it presents the appearance of an ordinary properly contoured full gold crown. (Fig. 384-C.)

Fig. 385.

While simple telescoping crowns are not successful as a rule, this method of procedure affords one of the best, most secure and permanent means of attachment, and when completed, both parts should be placed in position on the root, together with the other attachments, and the "bite" and impression taken, after which the bridge may be completed in the usual manner.

Inlay Attachment. The other form of attachment to molar teeth involves simply cutting a cavity and using an inlay and "split-post." In this procedure the tooth is devitalized and cut on the occlusal surface about one-half the length of the crown and down on the mesial side to allow for a heavy round bar of about 13 ga. and a good thickness of gold. The pulp chamber is filled with gutta-percha and the cavity shaped as illustrated in Fig. 385, leaving the sides curved and non-retentive. Pure gold about 34 or 35 gauge is then burnished into it as for an inlay, being careful to have the margins perfect. A hole is then made near the distal end of the matrix and through the gutta-percha to the floor of the pulp chamber and in it is placed an iridio-platinum tube large enough to take a 13 or 14 ga. wire post. Wax is now packed tightly in the matrix and around the tube, and it is then removed and after placing a piece of pure gold across the approximal side so that it can be entirely and evenly filled to that point,

it is invested and filled with coin gold, thus making a perfect gold inlay with a tube extending through it. (Fig. 386-A.) A groove is now cut from the tube to the mesial end of the inlay. The bulk of the cutting can be quickly done with a thin, round-edged carborundum wheel (Fig. 386-B), and finished with a fissure bur of the same size as, or very slightly larger than, the inside diameter of the tube. A flame-shaped finishing bur can be used to round the corner at the entrance to the tube and to give a slight downward slant to the mesial end so that the bar



a b

Fig. 386.

b

a

Fig. 387.

will not come above the cusps of the dummy. Figure 387-A shows a section of the inlay and tube in position in the tooth with the bar and "post" in place. The latter is made of halfround iridio-platinum or platinized gold wire, bent double and soldered to within about a quarter of an inch of the end and filed or turned to exactly fit the tube and grooves. It is then bent so that it will lie in the groove closely and the closed end filed so that the "split-post" can be slightly opened, giving it a spring which will hold the piece firmly in place. The inlay with the "post" in position is then placed in the tooth and the "bite" and impression taken in plaster, the inlay coming away in the impression. The model is then prepared and the bridge made, the bar being soldered firmly into it. (Fig. 387-B.) When it is finished, the sides of the inlay are roughened or grooved slightly, and it is then connected with the bridge and cemented as though it were a fixed piece.

This attachment has been used by Dr. Peeso with great satisfaction for a number of years in molars and in a few instances in bicuspids, but in the latter application good judgment must be used, as a bicuspid is much weaker than a molar. The same principle in a modified form, and applied to *gold crowns,* has also been used for a long time with unvarying success.

Interlocking Occlusal Rest.

An interlocking occlusal rest to be used upon one end of a bridge, in conjunction with one of the preceding attachments upon the other end, and which, when indicated, and particularly when adapted to molar

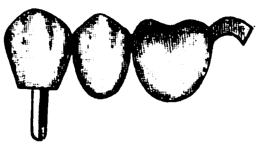
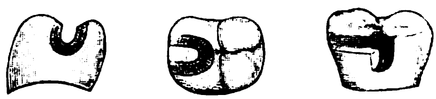


Fig. 388.



a *b*

Fig. 389.

teeth, as illustrated in Fig. 388, serves the purpose nicely, is made as follows:

A cavity is made in the mesial side of the crown of the molar, extending distally to about half the length of the occlusal surface (Fig. 389-A), and a *hard* gold filling very thoroughly condensed and perfectly made of No. 60 rolled gold, inserted. A groove, countersunk at the distal end far enough from the mesial so that there will be no possibility of its giving way under the stress of mastication, is then cut in the filling. Fig. 389-B shows this in sectional view. The bite and impression is now taken with the rest, and other attachment, in place; the model obtained, and the bridge made and finished as usual. It is usually best to put an orange wood stick or something similar between the abutments in order to keep the space from closing up while the bridge is being made, as sometimes the teeth will move very rapidly. The rest can be made of round iridio-platinum or platinized gold wire of No. 14 to 16 gauge.

When this type of support is used in conjunction with a tube and "split-post" attachment, as in the case illustrated, the fixture is very strong, the bar resting in the gold filling in the molar getting the full support of that tooth, and the hook overcoming the possibility of the teeth spreading, while the "split-post" and half band crown on the other end holds the piece rigidly in place. If it is to be a porcelain bridge, a

very thin piece of mica should be placed between the halves of the "split-post" in order to prevent their being soldered together while the piece is being baked.

In the hands of a skilled operator these methods are eminently successful and afford opportunity for obtaining most practical and artistic results, but the detail must be very carefully executed, else the work will be a failure as a result of the extensive weakening of the supporting teeth; or of faulty adaptation, or of lack of perfect parallelism between the parts.

The permanent mounting of the parts which are to be affixed to the roots with cement, should never be made until the case is completed, and the whole fixture should then be forced to place at the same time in order to insure the proper adjustment.

Patented, Manufactured, and Special Attachments in Removable Bridgework.

CHAPTER XXVII.

The Roach Attachment. The Condit Attachment. The Morgan Attachment. The Griswold Attachment. Kelly's Method. United Abutments: Bryant's Methods, Fossume's Methods.

Patented and Manufactured Attachments.

Several patented and manufactured "systems" of attachment for removable bridgework and partial dentures have been more or less generally used, and while none of them has by any means succeeded in entirely revolutionizing the construction of this class of work, some have been abandoned, while others are doubtless practicable and may often be even desirable.

These attachments vary considerably in design, but are usually composed of two parts which telescope into or over one another, one of which is to be securely attached to the supporting tooth, and the other to the removable fixture.

Advantages. The advantages which are to be derived from the use of such forms of attachment lie in the facility with which anchorage to the supporting teeth may be obtained; in the more or less secure means of fixation which they afford; in the fact that the parts are usually *machine-made,* and, therefore, accurately adjusted in their relation to one another, and that they may be obtained ready for immediate use directly from the manufacturer or dealer, thus saving the expenditure of time and energy in devising a means of otherwise retaining such pieces.

Disadvantages. Notwithstanding the numerous possible advantages, however, such attachments as are even yet used and recommended are neither universally applicable, nor, as a rule, free from objectionable features. These are usually, first, *inherent weakness,* which results in their soon becoming broken; second, a demand for such precise and accurate parallelism when two are to be on a single piece, as to require the use of a paralleling instrument, and the exercise of a greater degree of skill than is ordinarily possessed by the average dentist, thus making their use too intricate and uncertain; third, the extent of space occupied by the attachment itself, and obtained at the expense of the adjustment of the teeth to be supported by the fixture; fourth, the possible subsequent loosening of the parts in their inter-relation, as a result of continued friction and stress, which may soon render them useless; fifth, a lack of provision or opportunity for easily overcoming this, or for tightening the adjustment; and sixth, the leverage imposed upon the supporting teeth, which may be so severe as to result in their subsequent loosening, or ultimate loss.

Indications. Whenever opportunity for minimizing these objectionable features seems to present, and whenever suitable anchorage teeth remain in the mouth, and the form of attachment best adapted to the case is judiciously selected, and properly and skilfully adjusted, such attachments may be successfully employed.

The Roach Attachment.

Although among the most recently devised, the form of attachment designed by Dr. F. E. Roach, of Chicago, and known as the Roach Attachment, is one of the strongest, simplest and most generally applicable methods, and is given precedence over all similar forms, for the following reasons:

First, the area of actual contact between the parts of the attachment in their relation to each other is so small that, while the fixture is more or less rigidly retained, yet some degree of mobility is afforded, and thus the leverage or tipping strain thrown upon the supporting teeth is greatly reduced.

Second, this small area of contact allows considerable latitude in the adjustment of the parts, and absolutely accurate paralleling is, therefore, not required, thus simplifying the adjustment and overcoming the need of a paralleling instrument.

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Second, this small area of contact allows considerable latitude in the adjustment of the parts, and absolutely accurate paralleling is, therefore, not required, thus simplifying the adjustment and overcoming the need of a paralleling instrument.

Third, the attachment possesses a maximum of strength, and yet, in proportion thereto, as compared with similar forms, it occupies a minimum of space.

Fourth, the parts may be used interchangeably on either the "fixed" or *"removable"* part of the piece, and are also equally applicable to fillings or crowns; or to porcelain, gold or vulcanite work, thus increasing the range of application and usefulness.

Fifth, in the event of subsequent loosening they may be easily tightened, and opportunity for accommodating the fixture to an almost unlimited degree of subsequent settlement is also afforded.

The Attachment.

The Roach attachment comprises two parts which may be described as follows: Part 1 is a slotted round tube of 26 gauge gold clasp metal (Fig. 390-A), and part 2 is a solid ball with a projecting stem for attachment to the denture (Fig. 390-B). The stem has a shoulder near the

b.

Fig. 390.

a.

ball which serves the dual purpose of strength and finishing line, and the extreme end of the stem has a large head for secure anchorage in vulcanite work.

The ball end of part 2 accurately engages into part 1, and the rigidity of the spring metal of which the tube is made maintains a continuous tension on the *circumference* of the ball, thus affording a firm anchorage for the denture, yet admitting some little play or mobility.

Application to Vulcanite Work.

As applied to vulcanite work having made the abutment pieces in the form of either gold telescope, or open-faced, or of porcelain-faced, or all porcelain dowel crowns, take the "bite" in wax and the impression in plaster, with the crowns in place, removing the latter with the impression. Fill the inside of crowns with wax, run model, and then remove the crowns from model, clean out the wax from inside of them, replace them on model and wax part 1, to place on crown. If a gold crown the tube may be held, while soldering, with a pair of round-end tweezers as in Fig. 391, but when a dowel crown with porcelain

facing and gold back, or of porcelain, as illustrated in Fig. 392, or a gold inlay, is used for abutment piece, investment will, of course, be necessary.

After tubes are soldered on, the crowns should be placed on model, part 2 adjusted to place, and the teeth waxed up, being *careful to have the first tooth in good contact with the abutment crown.* Then flask the case so that crowns, attachment and teeth all come away together in one side of the flask, leaving only the model on the other side. Part 2 should now be removed and the tube, part 1, filled with *cement* and part 2 put back in place. The inside of the tube should be well filled, and a thin layer of the cement should also be placed all over the outside and up to the shoulder on part 2.

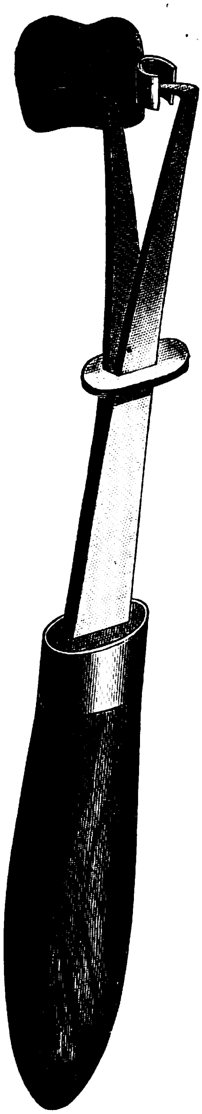

Fig. 391.

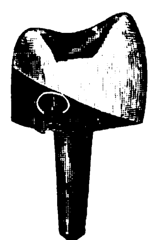

Fig. 392.

This luting of the joints is necessary to prevent the ingress of the vulcanite.

Application to Gold or Porcelain Work.

As applied to gold or porcelain work the procedure is the same as above indicated except, of course, that a metal die and counter-die must be made and the saddle swaged, after which the saddle is placed on the model and the ball (part 2) adjusted to its proper place in the tube and in relation to the saddle, and secured to the latter with hard wax. The saddle, with part 2 thus attached, should now be carefully removed from model, invested and soldered. Saddle and abutment crowns should then be adjusted to position in the mouth, and a good combination "bite"

and impression in wax will then be sufficient for the completion of the case in the usual manner in either gold or porcelain. In running this model, however, do not flow wax in crowns, as it is desirable to have them held securely on model.

Application to Gold Inlays.

Where gold inlays are to be used for abutment pieces for vulcanite cases, the typical application of which is illustrated in Fig. 393-A, flasking will of necessity vary. In such cases the abutment pieces and attachments will have to remain on the model side in flask, and to

Fig. 393. A.

prevent undue shifting of stem of attachment, it will be necessary to carefully pack rubber between it and the model before closing the flask. Figure 393-B, shows a typical type of construction in which the attachment is made both to an inlay in the cuspid, and to a gold crown on the molar.

Precautions.

The following precautions will greatly facilitate the application of these attachments.

First. If the tube (Part 1) is placed so that it will be in alignment with the lingual surface of the teeth, and well down toward the gum, it will thus be entirely out of the way in all cases.

Second. In soldering the tubes to the abutment pieces do not attempt to do so until you have the latter on a good accurate model, as they can then be placed in proper position to much better advantage. Then wax them where you want them, and grasp them with soldering tweezers as illustrated; or remove and invest, as the case may be.

Third. In cases made of gold with vulcanite attachment it is usually a good plan to first solder the attachment to the saddles and then take a good combination "bite" and impression in wax, with the base and abutment pieces all in position.

Fig. 393. B.

Fourth. In cases where the abutment pieces have already been cemented in the mouth, part 2 should be put to place with a bit of wax between *stem* and *gum* and a plaster impression taken. If it does not come away with the impression, remove and carefully place it where it belongs therein, and then slip a duplicate tube over ball and run up model. This supplemental tube should be about half an inch in length so that it will securely hold part 2 in place on the model during the construction of the case.

Fifth. Should the head on the stem interfere with the proper adjustment of the first tooth it may be filed off on that side without injury. For a very close bite a "saddle-back" tooth placed next to the supporting tooth may be used to advantage.

Variations. In cases where it would seem advantageous to reverse the application of the parts, and anchor the *ball* instead of the *tube*, to the abutment piece, or even to the *crown* of a *natural tooth*, that may be done. Indeed the latter application which is illustrated in Fig. 394, is often a most useful procedure. In such cases a hole the size and depth of the stem of part 2 is drilled into the tooth with a drill provided for this purpose, and the surface of the tooth around the hole then faced off so that the shoulder on the pin will set flat against the tooth. The head on the end of the stem must, of course, be filed off, and the stem must be filed flat on one side and thoroughly roughened, to prevent the possibility of becoming loosened afterward, when

Fig. 394.

Fig. 395.

it may be cemented to place. The tube in such cases must then be secured to the denture by soldering an extension of wire or heavy plate to it.

Fig. 395 illustrates a not uncommon case where a single attachment would answer the purpose, provided the ridge were high, and prominent, and the bite not too long, and more extensive cases with outline of saddle, or base, indicated, and in which this method of attachment would be particularly and typically useful are illustrated in Fig. 396 A and B.

Mounting. As a rule the permanent mounting of the abutment piece with cement, should be made after the attachment has been finally secured to and becomes a part of the removable piece. They should then be mounted simultaneously and the removable piece at once forced to place and held in its proper position until the cement has become thoroughly hardened. By this means the proper adjustment is insured, and the same precaution should be observed in all of the succeeding similar methods.

Fig. 396. B.

Fig. 396. A.

The Condit Attachment.

Another form of anchorage which is designed to be used in connection with some type of artificial crown exclusively, and which has been more or less extensively used for a number of years, is manufactured by the Dental Improvement Co. of Mt. Vernon, Ohio, and is known as the Condit Attachment.

This attachment, while made on lines somewhat similar to the preceding one in that the telescopic principle is involved, has a much greater surface contact between the "fixed" and "removable" parts. This allows practically no play and, therefore, makes a perfectly vertical position, and absolute parallelism, essential when more than one attachment is used on a single case.

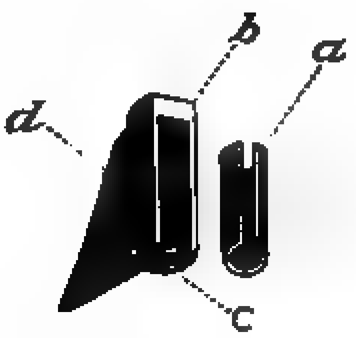

Fig. 397.

While this demands the utmost accuracy in using the attachment, still the same is true of most methods of anchoring removable appliances, and hence is perhaps not always to be regarded as a particularly objectionable feature.

The Attachment. The attachment, which is illustrated in Fig. 397, consists of a gold clasp tube (a) open at the side and both ends, which is to be soldered to the supporting crown, and a telescoping tube, called the *shield* (b), which is open at one side and at one end. This has a round *pin* (c) with tapering point which passes through the center and is fastened to the closed end, and is also provided with a V-shaped metal projection (d) placed on the side of the telescoping tube (b), opposite the opening, for the purpose of affording attachment to vulcanite, but is not used in metal work. As the pin passes into the tube (a) the latter embraces it with a tension proportionate to its spring, and rotation is in turn prevented by the telescoping tube fitting closely to both sides of the inner tube.

The attachment is machine-made from a solid piece of metal, and the parts are uniform in size, interchangeable, and sufficiently long for any length of "bite." In some cases, however, it may be necessary to

shorten them, but in so doing the end of the pin is made blunt. This would make it difficult to insert it in the tube, hence it must be retapered, and an implement for this purpose is provided, as is also an instrument adapted to cleaning out the attachment after vulcanizing and polishing, both of which are to be used in the engine.

Aside from the possible danger of breaking off this pin, and the extent of space occupied by it, this form of attachment may be found useful.

Fig. 398.

Application.

The attachment is furnished in iridio-platinum as well as gold, and is, therefore, applicable to either porcelain, gold or vulcanite work. While the adjustment of a single attachment may be made with the eye, in those cases in which two or more are used on the same piece, it is absolutely necessary that they be placed in a vertical position, and parallel with each other, and for this purpose a very simple paralleling instrument is used.

When the crowns which are to support the "fixed" part of the attachment have been completed, a good model with them in position thereon should be obtained, and the tube part of the fixture then temporarily attached to the crowns with wax, by means of the paralleling instrument, Fig. 398, after which they should be removed and soldered.

Metal Work.

In metal work, the base should be swaged and fitted and the impression then taken with it and the supporting crowns in position. The adjustment of the respective parts to their proper position, and their subsequent attachment with solder may then be effected on the model, after which the crowns should be permanently mounted with cement, and the removable

fixture forced to place and allowed to remain until the cement has become thoroughly crystalized, when a combination "bite" and impression may be taken and the case finished in the usual manner.

Vulcanite.

When the case is to be made of vulcanite, the crowns should be permanently mounted with cement as soon as the tubes have been properly attached to them, and the removable parts of the attachment should then be placed in their respective positions on the crowns and the "bite" taken in wax,

Fig. 399. A.

Fig. 399. B.

and the impression in plaster. These parts should come away with the impression upon removal, and it should then be observed that they occupy their proper position therein. A supplemental tube, which is provided, and which will anchor them securely to the model during the process of construction and vulcanization should now be placed in position in each attachment, and the model then obtained, after which the "bite" may be adjusted, and the case finished as usual.

A simple and quite common application where but a single attachment is used is illustrated in Fig. 399-A, while a more extensive case involving the use of two attachments is shown in Fig. 399-B.

The Morgan Attachment.

Another type of attachment which is to be applied in much the same manner as the preceding one, is made by Dr. J. B. Morgan of Davenport, Iowa, and is known as the Morgan "system" of anchorage. While this form of attachment is more simple in its construction, and is apparently much stronger than the former, yet the telescoping parts fit so closely that accurate parallelism in their adjustment is also necessary, and little or

A *Fig. 400.* B

Fig. 401.

Fig. 402.

no opportunity is afforded for tightening the parts when loosened by friction, or for accommodating subsequent settlement.

Attachment. The attachment consists of a curved and flattened tube, Fig. 400-A, into which a two-armed anchor piece closely telescopes, Fig. 400-B. The curved piece (a) is called the "keeper," and this is to be firmly affixed to the supporting abutment piece. The anchor piece (b), which fits snugly into the "keeper," has a projecting stem which passes between the open ends thereof, and furnishes a means of anchorage for vulcanite, or of opportunity for attachment to a metal base by soldering, and a cap or cover-piece which limits the range of adjustment.

Application. The parts are made in both gold and iridio-platinum, and hence are applicable to either vulcanite, gold or porcelain work, and to dowel crowns in either gold or porcelain (Fig. 401), as well as the ordinary gold telescope crowns.

As absolute parallelism is demanded, the *modus-operandi* incident to the application of these attachments is practically identical with that described for the preceding type, and a paralleling device called a "jig,"

Fig. 403.

and supplemental tubes for securely holding the anchor piece to the model in the construction of vulcanite work, are provided.

A case which will serve to illustrate the typical application of these attachments is shown in Fig. 402.

The Griswold Attachment.

Among the several methods of attachment which have been devised and extensively recommended for their practicability and more or less universal applicability are those introduced and known to the profession as the "Griswold System."

These embrace three different types of anchorage, designated as the "Spring Studs," and "U" Springs, which are shown in Fig. 403, and the "V" Attachment. While the two former have been practically abandoned because of proving entirely inadequate to the demands of removable fixtures, and of being too intricate, the latter may be found more or less useful, though it is doubtful that it possesses any particular advantages over the previously mentioned attachments.

"V" Attachment. This attachment is similar to the Morgan one, and may be used in much the same manner. It consists of a pair of telescoping "V"-shaped open tubes with corrugated sides (Fig. 404-a), one of which is to be affixed to the abutment piece, and the other to the removable part of the fixture (Fig. 404-b).

a   b

Fig. 404.

Fig. 405.

Application. These attachments are made of a special alloy which it is claimed will not lose its resiliency when subjected to the degree of heat necessary to fuse 22-K solder. Thus their application is limited to gold or vulcanite work, unless they may be attached to porcelain work after the piece has been baked.

For vulcanite work it is recommended that the removable parts first be united with a wire, as shown in Fig. 404-b, after their proper adjustment has been secured, if possible, and that the attachment of the teeth thereto then be made with vulcanite in the usual manner, while if a gold base or saddle is to be used, the attachment of the parts should be made to it instead of to the wire.

The technique incident to the application is otherwise practically the same as required for the two former methods. Fig. 405 illustrates a typical case.

Kelly's Method.

Another form of anchorage for removable pieces which may possibly have some field of usefulness, has been devised by Dr. J. L. Kelly of St. Paul, Minn. This embraces a pair of short telescoping tubes with one end closed, which are machine-made, of iridio-platinum, 28 gauge, and in sizes varying to meet the demands of the tooth to which they are to be adjusted.

Application.

In the application of this method, the root is prepared as for an ordinary dowel crown with a band, and the usual form of cap is made of 28 gauge platinum and fitted thereto, after which the "bite," and an impression in plaster, is taken with them in position. The caps should then be filled with wax and the model obtained. The edge of the inner or smaller of the telescoping tube should be filed to fit the floor of the cap and so as to sustain a vertical position thereon and this relation made permanent by soldering.

When the caps are thus completed they should be replaced upon the model, and the telescoping part, or larger tube, fitted and adjusted to them. As a means of retaining these in their proper relation to the caps, and to each other, they should now be fitted and soldered to a metal base, or wire, and the case then completed in the usual manner. Fig. 406 shows the application to a typical case.

The size of these telescoping tubes, and the alloy of which they are made, doubtless afford some degree of strength, but the space occupied by them is obtained at the expense of the crown of the natural tooth used to support them, and of the adjustment of the artificial teeth to be supplied, and these features, together with the fact that a vertical position and absolute parallelism must prevail; that they must become loosened in time as a result of friction, and that no opportunity for subsequent settlement is afforded, makes the method one of limited practicability.

Fig. 407.

Dunn's Method.

A very simple method of obtaining anchorage for "removable bridges" or partial dentures which may sometimes be found useful is advocated by Dr. J. E. Dunn of Chicago.

In this method the anchorage of the piece is obtained by constructing a gold or porcelain crown with a lingual shoulder, formed by an extension of the cusps at this point, as illustrated in Fig. 407, and by then making the fixture so that it will spring to place over this projection, and adapt itself snugly to the body of the crown.

Where the principle may be applied to supplying the lower posterior teeth, and where a stiff springy clasp metal wire such as has been previously recommended for lower cases may be used; or where, in similarly favorable cases, a vulcanite base may be made thin and springy, this method offers a very simple and practical means of anchorage.

Similar Methods.

A considerable number of methods of similar character have been devised, and while some of them may possibly have a limited range of application, and may still be used to an extent, many are already obsolete,

and others are not included for the reason that they are not regarded as possessing such special merit as to warrant separate consideration.

The Principle of United Abutments.

The application of bridgework in a mouth where the remaining natural teeth are more or less loosened, is always a problem requiring the most careful study. It is evident that if a denture is to be supported by abutments, whether permanently attached, or removable, more than normal stress must be resisted by these abutments, and if they are already weakened, either by disease or the loss of alveolar support through recession of tissue, the utilization of them becomes a hazardous procedure. It is also evident, then, that if something more than a temporary result is to be attained, the denture must be constructed with especial reference to the looseness of the supporting teeth.

It is an important fact, proven by repeated experience at the hands of those who treat pyorrheal conditions that the binding together of two loose teeth often more than doubles the stability of both. This is partly due to the prevention of movement in at least one or two directions, with the result that the supporting alveolar tissues are afforded opportunity of reattaching to the roots. Applying this clinical fact to bridgework a means of rendering even quite loose supporting teeth more or less useful is at once afforded.

Bryant's Methods.

Dr. Emory A. Bryant has recommended in these cases the use of a combination fixture a part of which is permanent, while the main portion may be removable. For example, a case might present where the molars and second bicuspids, as well as two or more of the incisors may be absent from the upper arch. Examination shows that the remaining first bicuspids are somewhat loose. The natural crowns of these are removed, the pulps extirpated and abutment crowns made for them. Between these bicuspid abutments a stout iridio-platinum bar is formed to lie snugly against the gum tissue, and to this bar are fastened the substitutes for the missing centrals. This, attached to the bicuspid abutment produces a permanent bridge for the anterior part of the mouth. To the abutment crowns, are fitted the Bryant clasps already described, and these are attached to the removable denture which is to bear the molars and second bicuspids.

Even where no teeth are missing in the incisive region, however, it is often wise to thus attach the abutments to one another.

Fossume's Method.

Dr. F. L. Fossume has constructed a number of ingenious dentures in which the principle of uniting the abutments is followed in a somewhat different manner. The advantages are reinforcement of loosened supporting teeth and greater stability of the piece, all lateral motion being avoided. It must not be understood, however, that this style of fixture is applicable *only* to loose teeth, for, on the contrary, the more stable the abutments the more rigid will be the denture in use.

Application.

The application and variations of Dr. Fossume's appliances may best be described by illustrating a few typical pieces. Fig. 408 gives views of a model, on which is seen the apparatus which unites the supporting teeth, while above it is the removable denture. In this case the pulps were removed from the two cuspids and both bicuspids, canals properly treated, and iridio-platinum posts accurately fitted to all the canals. Pure gold plate, 36 gauge, was burnished over the palatal surfaces of the cuspids, and the already prepared posts pressed through the gold into the canals, the ends projecting. Similarly, gold was burnished into the cavities in the bicuspids through which the pulps had been removed, and the posts pressed through. The posts

were tacked with hard wax to the gold matrices and each removed, invested and reinforced with high-grade solder. They were then restored to position in the mouth, each properly shaped and polished, withdrawn with an impression, models run, and for each side the cuspid and bicuspid parts united with solder. This produced practically a cast filling for each side, having posts that entered the canals of cuspids and bicuspids. These were again placed in position in the mouth and a new impression taken. On the resulting cast a heavy connecting bar of iridio-platinum square wire, was fitted and united to the abutment pieces as shown in Fig. 408. This was once more placed in the mouth and a

Fig. 409.

new impression taken, and from this final cast was swaged a platinum saddle which accurately fitted over the bar and against the gum tissue. At each end a small clasp of gold was soldered to hug the lingual surface of the cuspids; these permit tightening of the denture. Fig. 409 shows the application in the posterior part of the mouth.

Extension Bridges.

Dr. Fossume's success with the bar uniting two supporting teeth has led him to make a variation which is applicable where there is an abutment only at one end. Fig. 410 is a case like Fig. 409, except that there is no posterior abutments. For this case a shell crown was constructed for the bicuspid, and to this was soldered a short, square bar, at the extremity of which a cross bar was soldered forming a T. As before, the saddle of platinum was swaged to conform to the ridge and to engage the

bar. A stout clasp to encircle the gold crown was soldered to the saddle, and also carries a porcelain facing, which is made on the tube and "split-post" plan previously described. Fig. 411 shows the application where the posterior teeth are missing from both sides. The illustration is from one of Dr. Fossume's cases. The author would prefer to unite the two sides with a lingual wire in the lower jaw, and in the upper with a narrow strip across the roof free from the teeth. The construction is the same as in the last case, except that here dowel crowns were made for the cuspids and united with bicuspid shell crowns by soldering. In all of Dr. Fossume's cases the teeth are attached with rubber, but gold or porcelain may be utilized as the operator may elect.

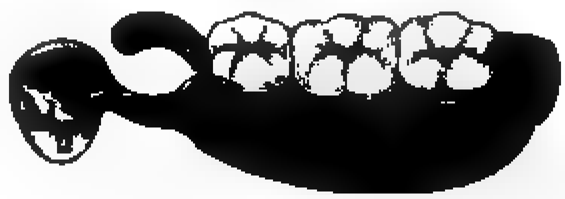

Fig. 410.

The Care of Dental Bridgework.

The duties which devolve upon the operator who constructs dental bridgework and who is interested in the success of his efforts, and in the welfare of his patients, do not cease upon the completion and insertion of the work, but also demand that he impart to the patient such instructions as to the care of the same as will promote the most favorable hygienic conditions of the mouth which is possible under the circumstances.

Those who are compelled to wear "Removable" bridgework, and particularly large pieces, should be advised to remove and carefully but thoroughly cleanse the fixture before each meal, and afterward, also, if possible, over a basin partially filled with tepid water, and with a suitable brush and a good soap; and that it is usually best to remove the piece upon retiring and place it in a glass of water, or preferably, in some good properly diluted antiseptic solution.

The former is essential as a means of removing all accumulated and decomposing secretions, and should be observed more particularly before meals than afterward, in order that the mouth may be free from such deleterious influences during the meal. Removal at night is equally important as a means of keeping the fixture itself in a thoroughly hygienic condition, and of allowing the tissues of the mouth to rest, and to assume

Fig. 414

their normal state, thereby relieving the capillary congestion and promoting the health of the parts.

The wearers of "Fixed" bridgework—which is at best more or less unhygienic—should always be advised of this fact, and so forcibly impressed with the necessity for scrupulous care as to be made aware of its importance. They should furthermore be fully instructed as to exactly how such care may properly be given. For the reasons mentioned a

thorough cleansing of the mouth, and of all surfaces of the work upon rising every morning, and previous to each meal whenever possible, should be recommended, and the proper style of brush and antiseptic solution should be prescribed.

While almost any good mouth preparation will answer the purpose, yet, any agent, however pleasant or potent, will fail to afford the desired results unless the patient has been made familiar with the requirements, and is then faithful in observing them—and these fundamental prerequisites will always depend largely upon the dentist himself.

Application of the Casting Process to Crown and Bridgework.

Application of the Casting Process to Crownwork.

CHAPTER XXVIII.

Application of the Casting process to the Construction of Single Crowns. Porcelain Crowns: Without Band, Selection of Crown, Cement Preferable to Solder, Requirements for an Ideal Tooth. Technique, Adaptation of Cap to Root-End, Selection of Tooth, Adjustment of Dowel, Adjustment of Tooth, Investing and Casting Base, Duplicates, Soldering Instead of Casting, Use of Ordinary Facings, Detachable Facings, Duplicates, Models, Casting against Porcelain. Advantages of Cementation, Gold Crowns; Construction, Short Roots, Models.

From even a cursory study of the almost unlimited array of procedures which have heretofore constituted the methods of practice involved in the construction and application of crown and bridgework, it will at once be observed that, notwithstanding the progress made, no one general or systematic line of procedure has ever prevailed.

While the myriad of individual methods and so-called "systems" which have from time to time been introduced and recommended, have embraced such varied and versatile efforts as to reflect great credit upon the ingenuity, progressiveness and enthusiasm of the profession, and while all of these have in a measure contributed to the development of this particular specialty, yet, until the advent of the casting process the methods of practice were necessarily largely empirical.

From the very first, however, the *casting process* seemed to portend such a scope of usefulness, and such an unlimited range of application to this, as well as to every other phase of prosthetic dentistry, as to ultimately revolutionize all former procedures. Indeed, with the development which has since been made along these lines, and which is still possible, most of them have already become more or less obsolete practices, and others will undoubtedly be abandoned from time to time as further development is made. In consequence, it seems safe to prophesy that fewer methods will be used, or needed, and that in the end better results will obtain.

This seems the logical sequence for the reason that *accuracy* of *adaptation,* combined with a *maximum of inherent strength* may be compared with, and, therefore, should be recognized as *the keystone of the arch* in the successful application of all forms of crowns and bridges; and since the process of casting has made these essential features possible to a degree never before achieved in this work, and since it at the same time simplifies and expedites the procedure, it is unquestionably destined to become the universal practice of the future.

By insuring the success and permanency of the cemented filling, which, when the cavity has been properly formed and the filling well adapted, is now generally recognized and conceded, a very large proportion of teeth which formerly were restored to usefulness only by some type of artificial crown may now be filled and thus restored in a better and more permanent manner. Because of the absence of the primary cause of cervical disturbances so frequently arising from some imperfection in the adaptation of the crown to the supporting root, such restoration must be regarded as a better procedure, whenever and wherever applicable, for the reason that no matter how carefully a crown may be fitted, no condition possible to obtain is quite so conducive to the permanent comfort and longevity of the root as is the normal.

The same degree of accuracy which insures the success of the inlay, however, is also possible in the construction of artificial crowns when they are demanded, irrespective of how well preserved or how badly broken down the root may be, or whether the crown is to restore but a single tooth, or to become part of a bridge in addition thereto.

Thus the possible irritating influences due to the presence of an artificial crown as formerly constructed are practically eliminated, and in addition to this the various forms of separable dowel or detachable porcelain crowns, instead of the ordinary thin facings, may now be successfully used.

Such types of porcelain teeth have always been regarded as being the nearest approach to the ideal, both in form, color and strength, and in principle of attachment to the metal base, or to the root and while, perhaps, not universally applicable even now, still their use, whenever possible, affords a distinctive advantage over ordinary thin facings. At best, when compared with an all-porcelain crown, the latter are generally of poor form, are always of doubtful color because of the necessary use and close proximity of a metal backing and the consequent loss of transparency and translucency, and are manifestly weaker because of the presence of platinum pins as an integral part of the facings, and of their rigid attachment to the supporting structure by soldering.

The presence of platinum pins in thin facings, such as are now in general use, has always been recognized as an inherent element of weakness, and the heating and soldering process has been, and still must be, regarded as a more or less doubtful and sometimes even dangerous procedure. Both of these objectionable features may be overcome, however, by the use of detachable or replaceable crowns or facings, and their subsequent attachment to well-adapted and strongly assembled metal parts by means of cementation.

As such an attachment is equally secure and manifestly safer than the more rigid and unyielding one resulting from heating and soldering; as such crowns or facings are certainly stronger than those in which the porcelain is necessarily weakened by the presence of platinum pins, and as opportunity for replacement in the event of accident—a contingency which is possible whenever and wherever porcelain is subjected to stress—is always present and favorable, this type of construction must ultimately become more or less general, and will be found applicable to all cases of favorable occlusion, and for which suitable forms of porcelain crowns may be obtained.

With these combined advantages and possibilities the construction of crowns and bridges may be accomplished with a minimum display of metal and a maximum degree of strength; and, therefore, with all of the cosmetic and hygienic qualities, and none of the doubtful features of modern porcelain work.

Crown Work.

In the application of the casting process to the construction of single crowns *two* general types will be found to meet the requirements in a very large percentage of cases.

As applied to the restoration of the ten anterior teeth or such teeth as are within the range of vision, or, in other words, where the cosmetic requirements demand the use of porcelain, the *detachable* or separable dowel crowns, such as the Davis, White, Justi, etc., with a thin well-adapted cast-base, offers the greatest possible field of usefulness, and the nearest approach to the ideal; while as applied to such teeth as are beyond the range of vision, or where the cosmetic requirements are secondary to those of inherent strength—both in the crown itself and in its attachment to the supporting root—no type of construction will, perhaps, ever take the place of a properly fitted and well-adapted gold crown.

Porcelain Crowns.

In the construction of porcelain crowns with cast bases, the requirements of root preparation are practically the same as indicated for any

other type of construction, except, perhaps, that the labial or buccal surface should be trimmed a trifle shorter than the gum line in all cases, as a means of insuring the complete concealment of the metal base.

Without Band.

When no band is to be used—and one is seldom necessary because of the possibilities of obtaining absolute accuracy in the adaptation of the cast base, to both the *end* and *periphery* of the root—the removal of the remaining ledge of enamel is, of course, unnecessary. When the root is cut down to the required point, however, all of the advantages of a band may be obtained by simply rounding off the extreme angle with a large round bur, thereby permitting a thin edge of the wax to be molded over and around the basal end of the root.

When the preparation of the root has been completed, unless a large selection of crowns are at hand, a wax or modeling compound impression should be taken, from which a model should be made to be used only for the purpose of facilitating the selection of a crown of desired size, form and color.

The mounting of a temporary crown and the dismissal of the patient at this point will be found advantageous as a means of compressing the surrounding soft tissue, and of thus obtaining a free exposure of the end of the root; and also of affording *opportunity* for the subsequent selection of the crown.

This procedure will also be found advantageous in those cases where the root is already badly broken down, as a result of accident, or as a sequel to decay and neglect, in which cases the casting process offers opportunities for obtaining an adaptation heretofore practically impossible.

Selection of Crown.

For the ten or twelve anterior teeth, where porcelain is demanded for cosmetic reasons, the all-porcelain replaceable or interchangeable crown, *with cast base,* and with or without a band, as the requirements may indicate, may be successfully used in a very large percentage of cases, and closely approaches the ideal form of artificial substitute for the natural tooth.

This type of crown is undoubtedly the strongest, most artistic, and most universally applicable substitute at our command to-day, and in all respects is second only to a skilfully adapted "jacket" crown. Indeed, for the average dentist it is more useful, more quickly and easily made, and, moreover, it possesses an advantage over the latter in that immediate replacement in the event of mishap is possible.

Again, this type of porcelain tooth is ideal for artificial crowns, because it affords better form, better color and greater strength than are possible to obtain from the use of facings, and because the presence of an occlusal surface of porcelain instead of gold, on any or all of the posterior teeth, is advantageous not only for cosmetic and hygienic reasons, but for *actual masticatory purposes* as well.

To overcome the shortcomings of the so-called "Richmond" crown, and of the ordinary bicuspid and molar dummy with porcelain facing and gold cusps, in bridgework, the advantages of some form of interchangeable or replaceable all-porcelain tooth, more closely simulating the form and color of the natural teeth, were early recognized.

These advantages have been so evident that the more esthetic operator has always hoped for some type of porcelain tooth, and some method of application which would eliminate the inherent weakness of thin facings, and the objectionable features incident to their use.

Cement Preferable to Solder.

If the esthetic and hygienic advantages possessed by this type of tooth, however, could be combined with those of exact adaptation, and uniform and adequate strength, and if to these might be added the further advantages of being *cemented* to the basic structure instead of *soldered,* and of being replaceable and more or less interchangeable, it is evident that our efforts would be a nearer approach to the ideal.

The attachment of porcelain teeth or even facings to the metal structure by means of soldering, or even of *direct casting,* is wrong, in my opinion. It is a wrong principle because the porcelain is subjected to a degree of heat which must endanger its structural integrity and influence the preservation of its color; because the tooth or facing is thus attached in a stiff and rigid manner at one or two points only, and, being friable, is more likely to fracture under the stress of mastication; and because, in the event of accident, no favorable opportunity for repair or replacement is usually afforded.

The elimination of these objectionable features must necessarily constitute an improvement, and such an improvement is to be obtained by the use of replaceable teeth attached to the supporting metal structure only by means of cementation.

An experience of many years has proved that this means of attachment is reliable in proportion as the adaptation of the metal to the porcelain may be close and accurate, or, in other words, in proportion as the porcelain may be "boxed up," protected and supported.

It is stronger when so attached because it is not subjected to any degree of heat, and is not held so rigidly at a single point, due to the adhesion of the cement over the entire surface, and hence it is less likely to become fractured. Furthermore, the color is never changed; those dark blue marginal outlines, due to the penetration of saliva between backing and facing are absent; and opportunity and facility for replacement, in the event of accident, always presents.

Requirements for an Ideal Tooth.

As previously stated, these possibilities and advantages are to be adequately obtained only in some form or type of tooth which presents as much porcelain as possible, this porcelain not being weakened by the presence of metal pins, nor by the provisions for retention, and which, therefore, possesses a maximum of strength; which is of natural form, more or less universally applicable, *and which will require but a minimum of grinding* in effecting the desired and required adaptation.

This latter feature, as applied to the retentive surface, is essential, because in proportion as a given form of porcelain tooth will require but little or no grinding upon this surface in effecting its adaptation to the requirements of the individual case, may it be expected to be replaceable or interchangeable.

These combined advantages, I believe, are to be obtained in a form of tooth suggested by the writer and now known as the "Goslee Interchangeable Crown and Bridge Tooth."

It will be observed that these teeth as now made are of natural form; that they possess the splendid strength and color characteristic of the Consolidated tooth bodies; that they are adapted to single crown work where any form of metal base is used, as well as to intermediate teeth, or "dummies" for bridgework; that they afford a minimum display of gold, and require but a minimum amount of grinding, and that with a sufficiently large variety of molds, they should be almost universally applicable; also that they are strongest where the greatest strength is required; and that they offer ample opportunity for secure retention to the supporting base or structure.

A further advantage made possible by the use of replaceable or interchangeable teeth, which applies particularly to especially difficult cases, is to be obtained by making duplicates, and while it is true that any form of interchangeable tooth is far less likely to become broken from the stress of mastication, yet the making of duplicates coincidently with the initial construction requires but little time, is always a source of inestimable protection to the particular patient, and affords unlimited relief and satis-

faction to the dentist. It is therefore a safeguard which might be observed often and profitably by everyone whose necessarily small fees do not render it prohibitive.

In all instances, however, whether duplicates are made or not, *the color number and mold number of each tooth used in every case* should be recorded on the card or ledger sheet, and thus made a permanent part of the record. Because of these advantages, and for these various reasons, I firmly believe that only some form of interchangeable tooth should ever be used if the best results and highest possibilities are to be attained in our efforts.

Technique.

In the construction of all forms of porcelain crowns with cast bases, however, and notwithstanding the splendid possibilities offered by the casting process, much difficulty has heretofore been encountered in molding the wax to a close adaptation to both the root-end, particularly at the periphery, and the base of the crown, and in holding the dowel or dowels in the proper position to insure correct alignment.

These essential features have usually been so uncertain, and in some instances so difficult and so unsatisfactory, as to cause me to suggest a technique which, when used in connection with the Goslee tooth, eliminates such uncertainty, insures accuracy, is applicable alike to all cases, whether a band is required or not; relieves the patient of any discomfort whatever, and which has proven the most satisfactory method of crown construction I have ever followed.

In the various methods now generally used and advocated, good, accurate, reliable results are difficult to obtain, because the very plasticity of wax of any kind makes it possess a tendency to *spread* when subjected to the pressure necessary to mold it to a close adaptation. This tendency is best and most easily overcome by first adapting 38-gauge pure gold or platinum to the root-end, which may be done either by swaging or burnishing; and then adjusting the dowel, tacking it to the base with solder, and subsequently molding the wax to both base and tooth, and casting directly to this disc of gold or platinum. If this procedure is carefully followed, the surface thus obtained will always fit more closely to the root-end than would obtain from the molding of wax alone, followed by the use of any investment material now procurable, and will require no finishing whatever after casting.

The use of pure gold is recommended only because of the facility with which a close and accurate adaptation may be obtained with it. Platinum of the same gauge, however, while a little more difficult to adapt, would answer the same purpose, and, provided the same degree of ac-

curacy be obtained, its use would afford an additional advantage in that any danger of fusing or burning it in casting to it would be entirely eliminated.

Such a procedure with either metal also reduces to a minimum the possibility of any distortion of form which may result from the warpage or shrinkage of the gold or alloy used in casting, and while the adaptation of the cap may be made by *burnishing*, the very best results are to be obtained by *swaging*. The latter necessarily involves the *indirect* or impression and die method, which is outlined in systematic order in the following steps:

Fig. 412

Fig. 413

Fig. 414

Fig. 415

Fig. 416

Adaptation of Cap to Root-End.

First: Prepare the root in the usual manner, as for any type of porcelain dowel crown. If a full or partial band is desired, all enamel should, of course, be removed.

Second: Adapt a base of thin, pure gold or platinum (about 38-gauge) to the root-end by swaging.

Third: This is to be easily accomplished by taking an impression of the root-end in modeling compound, Fig. 412, investing it in plaster, Fig. 413, and making a die of quick-setting amalgam or cement. An amalgam die is better and much more reliable, though it requires more time. The die should then be trimmed around the periphery with a fissure bur until the root-end is freely exposed. Fig. 414.

Fourth: Mount the die on the ring of any of the swaging outfits, with modeling compound, Fig. 415, and with the soft rubber plunger of a swaging device swage a cap of 38-gauge pure gold or platinum (Fig. 416).

Selection of Tooth.

Fifth: Select a Goslee tooth of suitable size and proper color. The selection of the tooth for the case at hand is best made by having a tray of sample molds, and when one of proper size and form has been selected simply record the formula. Thus, for example, the record slip would read, "*Upper Right Lateral, Mold* 51, *Color* 65." If care is exercised in selecting just exactly the proper size and shape, practically no grinding whatever will be required.

Fig. 417

In this connection, it would be better to select a formula just a trifle too small than one too large. If the exact size is not obtainable, small additions in length or width may be easily made in one bake, using any of the lower fusing bodies. Such additions are better than selecting a tooth which is too large, and having to grind it. Little or no grinding should be resorted to, as these teeth are replaceable or interchangeable only in proportion as they may be used without grinding.

In the absence of sample molds, an impression should be taken in wax or modeling compound, and a model made in plaster-of-Paris. Fig. 417. The selection may then be made upon this model, but greater accuracy is to be obtained in the use of sample molds directly in the mouth.

Adjustment of Dowel.

Sixth: When the tooth has been selected, the canal should be enlarged to receive the dowel or post. This should be cut to a length which will enter the root to a sufficient depth, and then engage and hold the tooth in its exact relation to the root. In single-rooted teeth a slight enlarging of the canal, or slight bending of the dowel, or both, will usually sustain the tooth in its proper alignment. In upper first bicuspids one dowel is usually all that will be required, but this should be placed in the *buccal* canal.

Iridio-platinum or clasp-metal dowels are preferable for cast work, though the nickel alloys may be used.

The dowel should be round, and not smaller than 14 gauge, though the end entering the canal should always be *tapered* to conform to the size of the root.

In casting to clasp-metal dowels, care must be exercised not to overheat the flask just before casting. Those who cast into red hot flasks, which is a mistake, often find that their clasp-metal dowels are melted

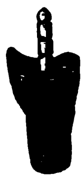

Fig. 418

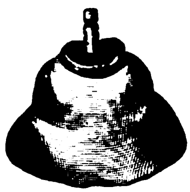

Fig. 419

Fig. 420

and absorbed into the casting, due only to an excessive heating of the flask in melting the gold. If the casting may be made into a flask only moderately warm, however, these alloys will withstand contact with molten 22-karat gold, but otherwise iridio-platinum pins and dowels should be used.

Adjustment of Tooth.

Seventh: When the dowel and tooth have been thus adjusted, the thin cap of pure gold or platinum should then be placed in position on the root, perforated to receive the dowel, and the latter, in position in the crown, forced to place. The tooth should then be removed, and the relation between cap and dowel sustained with wax or temporary stopping. Fig. 418. The two should then be removed from the root and invested with a very small bit of soldering investment material. Fig. 419. When this is hard, the dowel should then be tacked to the cap with a small bit of 22-karat solder, which will insure their permanent relation. Fig. 420. Cap and dowel should then be adjusted to position on the root, and finally trimmed and burnished to the desired accuracy of adaptation.

Eighth: The crown should then be ground to a close joint along the labial or buccal edge, and other requirements of adaptation completed. The base of the crown should now be painted with glycerine or thin oil, a small piece of soft, clean wax placed on the cap, and the crown then forced to its exact position in relation to the cap. The whole may now be removed from the root, and the space between metal cap and porcelain teeth filled with melted casting wax, preferably of a hard character. All

surplus wax should now be nicely trimmed away, and the porcelain crown then carefully detached, which is made possible by the lubricating oil.

No. 30 gold foil placed in direct contact with the porcelain tooth before filling the space between it and the cap as a means of facilitating the removal of the crown from its base, has been suggested by Dr. Ottolengui, and may be used with good results.

Investing and Casting Base.

When the porcelain crown has been loosened from the base, but before it has been removed, the sprue-former should be *securely* attached to the thickest part of the wax. The crown may then be

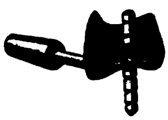

Fig. 421

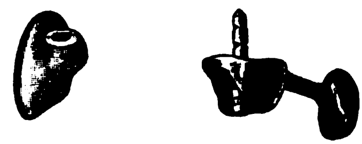

Fig. 422

removed, the base (Fig. 421) invested and cast, always using a clean, well refined grade of about 22-karat gold for the casting.

Duplicates.

When the casting has been made (Fig. 422), it should be cleaned in acid and finished. If duplicates are to be made, a crown of the same mold and color should now be ground to fit the cap. The original should then be cemented to the base and the crown polished.

Ninth: Whenever it is absolutely impossible to have a single dowel fit the canal, and at the same time support the crown in proper position, the surplus end projecting through the cap should be cut off close to the cap, leaving just a sufficient length to insure strength. A separate short dowel, such as is made for dummies for bridgework, may then be used to support the crown, and should be placed in position in the crown, any unnecessary surplus cut off to permit of proper alignment, the porcelain then lubricated, and the relation sustained in wax, as previously indicated, where a single dowel is used.

Soldering Instead of Casting.

Tenth: In cases where the space between the cap and the base of the crown is very small, or where it may not be convenient or seem necessary to cast the base, good results may be obtained with solder.

In such cases the porcelain tooth should be backed up with 38-gauge pure gold by burnishing or swaging (Fig 423); the crown and backing

(Fig. 424) then placed in position in relation to the cap, the porcelain removed, the case invested, and the space between cap and backing then filled with 22 or 20-karat solder.

This method is particularly useful in very short bicuspids, but where there is sufficient space to permit of casting, such a case is better and more uniformly strong.

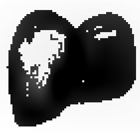

Fig. 423

Fig. 424

Fig. 425

The entire process reduces crown construction to a definite system, requires but little time, is simple, insures a more or less perfectly adapted base, and one which is obtained without the slightest discomfort to the patient, which is not possible when *burnishing* directly to the root-end is attempted.

For single crowns a very narrow lingual and approximal band is usually all that will be required. This strengthens the attachment between crown and root, and precludes the possibility of subsequent fracture of the root—for which purposes a band is usually used, but in all cases where the crown is to be used as a bridge abutment a *full* band should always be used.

The construction of a crown by this method usually involves but three short sittings, and the best results are to be obtained by doing all the work directly in the mouth. At the first sitting the root is prepared, the root impression taken, the mold number and color selected, and a temporary crown mounted.

A series of typical crowns constructed along these lines is illustrated in Fig. 425.

With Band. In cases where the use of a narrow, well-fitted band may seem necessary or advantageous one may be used, and such a type of construction is frequently indicated, particularly in such cases as have previously been crowned with this style of crown, and, hence, where the root has already been prepared for a band, and, therefore, needs similar protection, *or where it is to be used to support bridgework and, consequently, where every possible degree of strength in its attachment to the root is demanded.*

Fig 426

In such cases a narrow band of 30 or 32 gauge, 22 k. gold, or platinum, soldered with 22 k. or 20 k. solder, should first be carefully fitted to the root and then so trimmed as not to interfere with the proper adaptation of the crown, or to show upon the labial or buccal surface. When so fitted the crown should then be ground to place, the dowel adjusted, and the wax molded with the band in position on the root, as indicated. After molding the wax, removing the crown and wax base, and again assembling them out of the mouth, the band should then be detached from the root, placed in its proper position in the wax, and attached securely with a hot instrument. The surplus wax should now be trimmed down flush and even with the band and crown, and, since the band was made of a thin gauge metal, either 22 k. gold or platinum, if any reinforcement is wanted, the same may be accomplished easily by allowing a thin layer of wax to flow over the outer surface of the band, and especially over the joint which has previously been made with solder (Fig. 426).

The sprue-wire should now be securely attached at a favorable point, the porcelain removed, and the wax base with its band and dowel *in situ* carefully invested and subsequently cast. In casting it will be found that the metal cast will securely attach itself to both band and dowel, provided that both were *clean,* a precaution, however, which should always be observed; and the whole will constitute a strong, well-adapted base.

Use of Ordinary Facings.

While the use of the various forms of detachable or separable dowel crowns is undoubtedly productive of the most artistic achievements, and affords opportunity for combining with these the advantages of strength and replacement, the casting process, however, is equally applicable to the ordinary type of facing, such as is commonly used in the construction of the various forms of porcelain-face, metal-back, or so-called "Richmond" crowns. Indeed, in cases where an extremely long overlapping of the crown upon the opposing natural teeth demands a *long* and *very thin* facing, the use of any other thicker or more bulky form of porcelain tooth may be precluded.

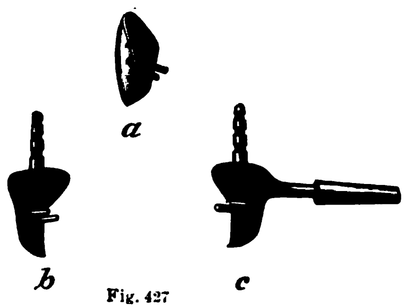

Fig. 427

In their use, where the root has been properly prepared, one which will meet the requirements of the case should be selected and ground to its proper adjustment in the mouth. When this has been accomplished it should be observed that the pins are not too long, nor long enough to interfere with the opposing teeth; are parallel with each other, and at right angles with the facing. A backing of pure gold from 34 to 36 gauge should then be perforated, slipped over the pins, and closely burnished to the facing, allowing a *very slight* surplus to project beyond the porcelain upon all surfaces (Fig. 427 A). The pins which have probably been somewhat shortened, should now be coated with vaseline or oil, and the backing attached to the facing by running a little melted wax over it and around the pins.

The dowel should now be fitted and placed in position in the root—and the band, also, if one is to be used—and a small quantity of soft wax warmed and molded over the end of the dowel and base of the root. The facing and its backing should now be gently forced to place in the wax. When the proper adjustment has been obtained and secured with a warm instrument, the wax should be chilled, and the whole removed and trimmed up to the desired shape and form, then again tried to place to insure the relation and adaptation of facing, wax and dowel to root.

When this is satisfactory the facing should be gently detached from the backing, by inserting a small-pointed instrument between them and lifted off. Small pieces of graphite points, of a size corresponding with, or very slightly larger, than the pins, which are made for vest-pocket pencils, and which may be procured at any stationer's, should now be forced through the holes in the gold backing and into the wax (Fig. 427 B), the sprue-wire attached (Fig 427 C), and the case then invested and cast.

The presence of the thin gold backing, subsequently reinforced by, and thus becoming a part of the casting, will insure a smoother surface presenting toward the facing than would, perhaps, be obtained in the surface of the gold which is cast, because this is usually rough in proportion as the investment material is porous, or of coarse texture. The graphite pins will preserve the holes and may be subsequently removed therefrom by boiling in acid, or with a small round bur of the same size. When this has been done the facing should be placed in position and the crown then finished to the point of polishing. The facing should now be removed and the pins threaded with a Bryant "tap" designed for this purpose, and to be used in connection with replacing broken facings; or notched with a file, after which it should be cemented to place, using a cement which in color approximates that of the facing as nearly as possible, and which should be allowed to crystallize thoroughly before the crown is finally polished.

Detachable Facings. The same detail is also applicable to the use of the "Steele" detachable facings, or to any of the other similar forms of *thin* facings, one of which has been suggested by the author, and will be described later in connection with bridgework, but which is also equally applicable to single crownwork.

Duplicates. Whenever any replaceable type of crown or facing is used, however, the greatest possible advantages are to be obtained by selecting and grinding duplicates of all teeth at the time the work is being constructed. When this procedure is to be observed the crowns or facings which are to be used at the time should first be ground to the proper adaptation, and the backing for them then made, after which the duplicates should be ground to fit the backing. While the latter is not always a simple proposition, it may be greatly facilitated by painting the surface of porcelain with black oil paint, such as comes in small tubes for artist's use. Articulating or carbon paper, or typewriter ribbon, may also be used for this purpose, although the first-mentioned method will be found preferable. When the duplicates are thus ground to fit the backings made for the originals

they should be placed in a small box, properly labeled, and preserved for future use in case of accident.

In any event the manufacturer's formula, or the mold number and color number, should always be obtained and entered upon the record as a means of enabling the operator to replace any particular tooth or facing at any time, or to communicate such information as will enable any one else to likewise serve the patient.

Models. Wherever it may for any reason seem advantageous, or necessary, to make models, and to obtain the proper adjustment and molding of wax upon them, rather than in the mouth, accuracy may be attained by first carefully and closely adapting a disk of thin pure gold or platinum, 34 to 38 gauge, to the end of the root or roots, subsequently attaching this to the dowel with a small bit of 22 k. or 20 k. solder, and with this in position then taking the impression with plaster. After removing the impression it should be observed that the disk and dowel are in their correct position therein, after which the entire length of the latter should be covered with a very thin coating of soft wax in order to facilitate subsequent removal from the model. This may be done to good advantage by melting the wax and painting it on with a small brush. When the model has been made of plaster, or a good investment material, the thin disk and dowel should be slightly warmed, then gently detached, removed and cleaned in the acid bath, after which it may be replaced, and the work of adjustment and molding of wax done thereon.

A more or less accurate model may also be made by first molding a small quantity of wax to the end of the root, with the dowel in place—and with the band also if one is used—and then taking the impression over this with plaster. With these in their proper place in the impression, when the model is obtained and the wax gently and carefully removed, a good smooth outline of the end of the root will usually present. The band, if one has been made, and the dowel should first be detached and cleaned in acid, and the model then varnished and oiled, after which the proper adjustment of the parts, and the molding and carving of the wax may be accomplished with facility and reasonable accuracy.

Casting against Porcelain. While the removal of the porcelain crown or facing from the wax prior to investing and casting, and its subsequent attachment to the metal by means of cementation, possesses indisputable advantages, some, however, may prefer to include the porcelain in the investment, and cast directly to it. This may be done easily since such a procedure involves only a question of heat, and this demands that the investment and porcelain be heated to a very red heat before, and remain at this tem-

perature at the time of casting. If this be carefully done any of the metals or alloys used in casting, and favorable to the requirements, may be cast directly to the porcelain, which will thus become an integral part of the piece, and two, or even more, facings or crowns may be included in the same casting, provided, also, that sufficient space exists between them to allow for a probable shrinkage of the metal in cooling.

The only supposed advantage to be derived from this procedure, however, lies in the fact that subsequent cementation of the porcelain to the metal is, of course, unnecessary, but instead of this being an advantage, it is regarded as a disadvantage, and the procedure, at best, is always fraught with uncertainty and danger, especially when the high fusing metals are used.

It is to be so regarded because the porcelain is thus unnecessarily subjected to a high degree of heat, the intensity of which always, at least, endangers the integrity and color; because the porcelain is attached in a more rigid and unyielding manner, and thus more likely to break under the stress of occlusion, and because no opportunity for replacement in the event of fracture presents.

Advantages of Cementation.

The elimination of all of these possibilities constitutes the very advantages obtained in the use of replaceable teeth cemented to place on the metal structure. For, since by means of casting it is now possible to obtain an adaptation of the metal to the porcelain which insures accuracy and uniform strength; and since attachment by means of cementation is conceded to be reliable in proportion as the adaptation is close; and as such attachment is undoubtedly stronger; when these are considered together with the further facts that the porcelain is not subjected to any degree of heat; that it is not held so rigidly and is, therefore, *less likely* to break; that its color is never changed and that replacement is always possible, the advantages must necessarily be regarded as unquestionable. It would, therefore, seem that this method of procedure is destined to be the more or less general practice of the future.

Gold Crowns.

The application of the casting process to the construction of gold shell or telescope crowns also offers many advantageous features. By this means the taking of impressions, the making of models and dies, and the necessity for swaging and soldering become unnecessary; all of the combined advantages of the *solid-cusp, sectional and seamless* methods are possible, and may be accomplished in less than, or approximately half of, the time previously consumed; and *better fitting,* stronger and

even more artistic results are obtainable in proportion as the operator's skill and knowledge of tooth form may be developed.

Construction.

In the construction of this type of crown by casting two general lines of procedure may be followed, but these differ only in the width of band fitted to the root, and the manner of obtaining form and contour to meet the requirements of alignment, contact and artistic effect, the occlusion being obtained in the same manner in both.

Because of the difficulty of obtaining a good close adaptation to the root around its entire circumference, and within the free margin of the gum, with so plastic a substance as wax, alone and unsupported, the use

a *b*

Fig. 428

of a band is absolutely necessary, and while some may prefer to use a narrow one and secure the desired and required shape and contour with wax, rather than to use a wide one and first shape it to comply with these requirements, the best and most uniform results are usually to be obtained by the latter method.

In the procedure which is regarded as being the most simple and expeditious, and at the same time productive of the best results, a band of 28 or 29 gauge, 22 k. gold, should be cut in the usual manner, soldered with 22 or 20 k. solder, trimmed to follow the cervical curvature of the gum, and fitted to the root, which should be prepared in the usual manner, at a point just within the free margin. When this has been accomplished it should then be contoured to conform to the buccal and lingual alignment of, and to restore contact with, the adjacent teeth, and the occlusal edge then trimmed until just free of the opposing teeth when occluded; and then filed smooth, after which it should be placed in position upon the root (Fig. 428 A).

A piece of hard wax, such as is used for inlays, should now be trimmed to such size as will fit into and fill the entire inside of the band and liberally accommodate the occlusion. When so trimmed this should

be heated in water of the proper temperature, and then forced into the band against the end of the root and over and around the entire edge.

The patient should now be instructed to close firmly into the wax, and then to indulge in the various movements of mastication in order that all such movements may be freely accommodated (Fig. 428 B).

When this has been satisfactorily accomplished, a pointed instrument should be inserted under the cervical edge of the band, and the whole detached from the root. The interior of the band should now be carefully filled with the same investment material to be used in casting

a *b*

Fig. 429

a *b* *c*

Fig. 430

in order that the relation of the wax to the band may be securely sustained while carving (Fig. 429 A). As soon as this has crystallized the surplus wax should be trimmed away until even and flush with the band, and the occlusal surface then carved in such manner as to preserve several points of occlusion, and at the same time round off all high interlocking points and typify the tooth (Fig. 429 B).

In those cases where a slight space exists as a result of the premature loss of a tooth (Fig. 430 A), the crown may be found in such manner as to afford an uninterrupted occlusal surface by simply allowing the wax to extend over into this space and subsequently carving it to meet such a requirement (Fig. 430 B).

Any additional reinforcing or contouring of the band may now be made by flowing wax over it at such places, and as the joint has been made with solder which very probably fuses much lower than the gold, of which the cusps are to be cast, it is always well to reinforce this with wax in order to preclude the possibility of its becoming opened in casting.

The sprue-wire should now be attached (Fig. 430 C), and the crown then submerged in water until the investment material inside of the band becomes saturated as a means of insuring a close union between it and the fresh matrix to be used, and then the investment for casting completed.

Where a gold band is used in this manner it is necessary, of course, that a grade of gold similar to that of which the band is made should be used for casting the cusps in order that a uniform color may prevail throughout the finished crown. Scrap gold, however, even though it contains some solder, may be used for this purpose if melted and refined

Fig. 431

with saltpeter and borax on a charcoal block previous to casting. Indeed, the presence or addition of a small proportion of solder so reduces the fusing point as to preclude burning the band, and increases the flowing properties to an extent which insures a good physical union.

Short Roots.

In cases where the supporting root is very short and, hence, where the occlusal surface of the crown would necessarily need to be extremely thick in order to fill the entire space between the end of the root and the cusps of the opposing teeth when in occlusion, and thus make the weight of the finished crown objectionable, or the cost possibly prohibitive, either one of two procedures may be used to advantage.

First, the root may be built up with amalgam or cement to approximate the length of the band, and thus diminish the thickness of the cusps; or, second, the unnecessary thickness of the wax forming the cusps may be reduced to a minimum by the use of the wax "suction carver," designed by Dr. F. E. Roach, of Chicago (Fig. 431). This is a most ingenious little contrivance and will be found almost indispensable in all forms of wax work. When used in this connection the thickness of the wax cusps should be diminished immediately after removing the crown

from the mouth, and before the interior of the band is filled with investment material as recommended, but care should be observed to preserve enough of the shoulder of wax which is adapted to, and rests upon, the end of the root to prevent losing the very great advantage of having the finished crown set solidly thereon (Fig. 432).

Fig. 432

Indeed, this is one of the paramount advantages obtained by this method, and explains the statement previously made to the effect that a better fitting crown is thus possible for the reason that crowns so made go to place on the roots much as an inlay does in a cavity; it is impossible to force them too far down, and, hence, less discomfiture follows after mounting, and a minimum quantity of cement is required to insure a maximum of strength in the attachment of crown to root.

a Fig. 433 b

In constructing a crown where a narrow band is used in preference to a wide one, the cervical end of the band must, of course, be fitted to the root with the same care and precision, but a thinner gauge of either 22 k gold or platinum may be used. A thickness varying from 30 to 32 gauge will answer the purpose nicely, since it is used only to insure the correct cervical adaptation, and is to have its outer surface entirely covered over with wax and subsequently with gold.

When properly fitted and burnished to a close proximity with the axial surfaces of the root, quite a large piece of wax should be trimmed to proper shape, heated and then molded over root and band and accommodated to the occlusion. When this has been accomplished the wax should be chilled and the whole removed. If the band is not removed with the wax it should be detached from the root, carefully placed in its proper position in the wax, and sealed with a hot instrument. The entire

crown may now be shaped and carved to meet the requirements of alignment, contact and occlusion, in which the outer surface of the band should be completely covered with the melted wax, allowing it to taper down until only the extreme cervical edge is exposed.

A method quite similar, but varying in detail in so far as the width of band is concerned, is recommended by Dr. C. E. Meerhoff, of Chicago. In this procedure the band is made somewhat wider, and in fitting is allowed to project a short distance beyond or above the basal end of the root. This projecting edge is then slit around its entire circumference, and each flap bent over until it rests upon the end of the root (Fig. 433 A after which the wax is molded and carved and the crown completed in the same manner (Fig. 433 B If any advantage is possessed by this method it lies mainly in the fact that the cap thus made is held more firmly in its relation to the wax than is a simple band, and, hence, any possible displacement during the process of carving is overcome.

Models. While all of this carving may be done at the chair and the crown tried in from time to time until the desired artistic results obtain, some may prefer, or may feel that they work to better advantage on models. In this event the usual bite and impression should be taken with the band in position on the root and a plaster model made and the case mounted upon the articulator. When separated the band should first be carefully detached from the model, cleaned in acid and replaced, after which the models should be coated with shellac varnish, followed with glycerine or oil to prevent the wax from adhering thereto and the wax then molded and carved thereon.

Since reproductions, however, no matter how carefully they may be made, are rarely ever as accurate as the original, the use of models is not recommended as a general practice and should be resorted to only when absolutely necessary.

Indeed, one of the beautiful features and one of the greatest advantages offered by the casting process is the very fact that so much of the work which was formerly confined exclusively to models may now be done directly in the mouth, and whenever possible this undoubtedly insures greater accuracy than models of any kind, for any purpose.

Application of the Casting Process to Bridgework.

CHAPTER XXIX.

Attachment to Natural Crowns of Teeth, Attachment to the Roots of Teeth. Fixed Bridgework: Posterior Dummies, Anterior Dummies. Inlays as Abutment-Pieces: Formation of Cavities in Posterior Teeth, Formation of Cavities in Anterior Teeth. Technique: Making Wax Inlay, Investing, Heating Up and Burning Out Wax, Casting. Opening the Bite: Splinting Loose Teeth, Combination of Cast Gold and Porcelain Teeth, Casting to Surfaces of Metal, Use of Base Metals and Alloys. Pin-Locked Inlays: Porcelain Crowns as Abutment-Pieces, Gold Crown as Abutment-Pieces, "Bite" and Impression, Models, Constructing Posterior Dummies, Saddle Formation, Wax Backing, Special Pins, Cast Pins, Sectional Backings, Use of Diatoric and Vulcanite Teeth, Use of Ordinary Long-pin Facings, Gold Dummies, Constructing Anterior Dummies: Replaceable Facings, Replaceable Crowns Used as Dummies, Ordinary Facings, Steele's or Evslin's Replaceable Facings. Typical Cases.

If the casting process has revolutionized and simplified the methods of procedure in the construction of single crowns, it has also exercised the same influences upon all forms of dental bridges, where the field is even larger and where the possibilities are, therefore, greater. It is *particularly* applicable to bridgework, and has revolutionized all former methods because of insuring a degree of accuracy of adaptation and of strength heretofore impossible; and it has simplified the entire field of effort because these same possibilities will reduce to a minimum the number of methods formerly used or now found to be necessary.

This is evidenced from one viewpoint, at least, by the acknowledged success and permanency of the inlay, and since the cast filling must be regarded as affording a means of restoration quite equal to an artificial crown, and in some respects even preferable, it must be classed as the ideal type of anchorage for bridgework.

Whenever and wherever it may be used the natural crown of good sound teeth, which heretofore would have been mutilated to a greater or less extent in obtaining anchorage for bridgework, may now be conserved, and at the same time equally good, if not better adapted, stronger, and, in most instances, less conspicuous attachments may be made thereto.

Attachment to Natural Crowns of Teeth.

With such possibilities and advantages the inlay, therefore, affords a more or less universally applicable method of obtaining anchorage to the *crowns of remaining natural teeth,* and, hence, its use must ultimately supersede all of the various other methods, such as open-face crowns, "groove," or so called "Carmichael," "plate and pin" attachments, etc., which until now have been in common use.

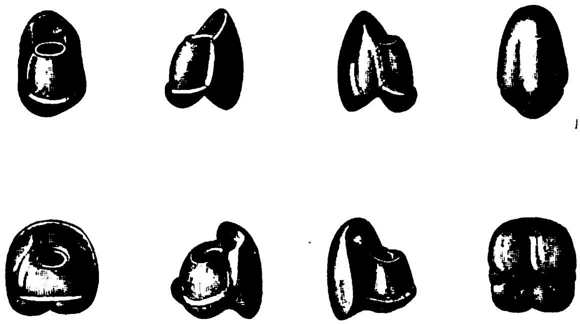

Fig. 434

Attachment to the Roots of Teeth.

Where the natural crown has been lost or sacrificed, however, to an extent which demands its complete restoration, and where the attachment must, therefore, be made to the root itself, some form of artificial crown must, of course, be used.

For this purpose two general types of constructions are universally applicable—the *all-porcelain, or porcelain-face, crown, with a cast base,* for such teeth as are within the range of vision, or, in other words, for the anterior teeth; and the gold crown with cast cusps for the posterior teeth thus embracing, when combined with the inlay, but *three* types of attachments which are generally applicable to, and which will meet the average and ordinary requirements of *fixed bridgework.*

Fixed Bridgework.

Since fixed bridgework constitutes simply an assemblage of attachments to the supporting teeth, or roots, and of the intervening "dummies" which substitute the missing teeth; and since the three types of attachments just mentioned are universally applicable for the former purpose, it is then only necessary to determine what form or forms of "dummy" will best meet the requirements of the latter purpose.

Posterior Dummies. As the advantages to be obtained by the use of replaceable teeth are especi..lly valuable in and particularly essential to the construction of fixed bridgework, *some form of porcelain crown, or tooth, with a cast backing,* undoubtedly affords the ideal means of constructing posterior dummies in the replacement of such teeth as are within the range of vision. For this purpose the Davis, White, Justi, Twentieth Century, and other similar forms of porcelain crowns with detachable dowels, may be so ground as to be applicable to a large proportion of cases, although a modification

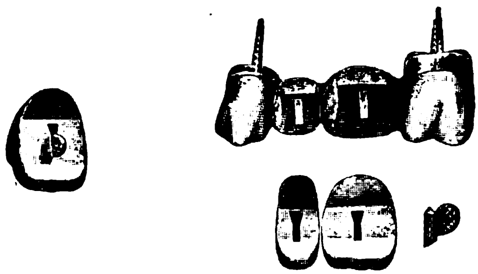

Fig. 435

of form more especially adapted to bridgework has been suggested by the author, and is now made by the Consolidated Dental Mfg. Co., of New York, Fig. 434 and the Evslin tooth made by the Pennsylvania Dental Mfg. Co., Fig. 435 While these forms will be found well adapted and more or less universally applicable to this purpose, the ordinary diatoric, or even the pin teeth intended for vulcanite work, may also be used in more or less similar manner.

When properly backed with a cast backing almost any of the various forms of replaceable porcelain teeth possess a maximum of strength, and yet afford a minimum display of metal, thus making a stronger, better and much more esthetic type of construction than the ordinary thin facing and gold occlusal surfaces now in common use. Indeed, the display of gold cusps in the construction of fixed bridgework has always been regarded as flagrantly inartistic, and some means of dispensing with them has long been desired.

Anterior Dummies. The actual requirements for anterior dummies differ mainly in that the extent of absorption in the region of the six anterior teeth in particular usually

demands a more or less *thin* form of tooth or facing. For this reason the separable dowel crowns, if ground as illustrated in Fig. 436, may be occasionally utilized wherever the extent of absorption is sufficient to admit, yet they are not universally applicable, though all of the advantages of a replaceable form of tooth which they possess are equally desirable.

While the ordinary long-pin flat-back facings may be used, as suggested in the construction of single anterior crowns, or the Steele and similar forms of so-called bridge-teeth, or even simple vulcanite teeth,

Fig. 436

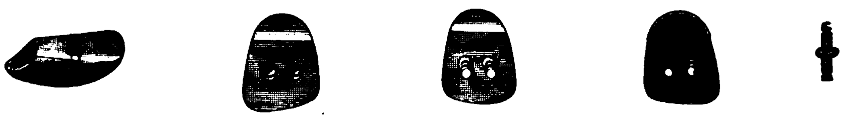

Fig 437

the author has suggested a type of tooth for this purpose which seems to offer a maximum degree of strength, the thinness usually demanded in application to the replacement of the eight anterior teeth, and all of the advantages of the replaceable form of tooth combined.

This type of tooth is identical in size and form with the ordinary facing, but instead of having pins in it, holes are placed in exactly the same postion and relation to the porcelain and to each other. These holes have a very slight shoulder or seat at the surface of the porcelain exactly like the Davis crown, only smaller, and are slightly countersunk at the lower ends. The shoulder at the surface of the porcelain affords accommodation for the thin diaphragms on the pins, which insures perfect parallelism between them; and the countersink at the end of the holes affords accommodation for a slight surplus of cement in mounting (Fig. 437).

The diaphragm is in the exact center of the pin, and is about 15 gauge in diameter and 30 gauge in thickness, and the pin is from 17 to 18 gauge, with each end notched as a means of facilitating the attach-

ment of the pins to the cast-metal backing, on one end, and of the porcelain facings to the other ends, with cement. They may be made of iridio-platinum, gold and platinum, clasp-metal, or any of the German silver alloys.

These facings are now in the hands of several manufacturers and will doubtless soon be procurable.

With these two general types for *antcrior* dummies, with the former type for *posterior* dummies, and with *cast-gold* dummies for such places in the posterior part of the mouth as present conditions of absorption and occlusion which preclude the use of any form of porcelain tooth or facing, embracing in all but three or four general types, it will be observed that the actual requirements in connection with "dummies" for fixed bridgework are practivally included.

Inlays as Abutment-Pieces.

In the application of inlays as "abutment-pieces" or "attachments" for fixed bridgework, in the formation and preparation of the cavity, every precaution must be observed to insure a secure mechanical fixation of the inlay. This is necessary because any inlay for a simple restoration, much less one which is to be utilized as a support for bridgework, which depends *entirely* upon cement for its retention, will usually fail, and particularly if it is to be subjected to stress in any direction.

In addition to such favorable mechanical formation, at least one, and sometimes two, short pins, made of from 18 to 20 gauge round iridio-platinum wire, should invariably be used in teeth having vital pulps, and larger and longer ones where the pulp has been removed, as a means of obtaining every possible degree of security and permanency in the attachment of the inlay to the tooth.

When such pins are used in teeth having vital pulps, holes should be drilled (using a bur of the same size as the wire) into the base of the cavity at a point which will be least likely to expose the pulp, and parallel with the axial walls of the cavity, and with each other, if more than one is used. They should extend into the dentin as far as possible without endangering exposure of the pulp, and project beyond the hole and into the body of the cavity sufficiently to admit of their becoming securely attached to the wax in molding it to the cavity. When so fitted they should then be threaded with a "tap" or notched with a file to insure attachment of gold in casting and of cement in mounting (Fig. 438 A).

In pulpless teeth one pin is all that is necessary, but this should be about 16 gauge in size and should extend through the pulp-chamber and into the canal to a slightly greater extent (Fig. 438 B). In cases where it seems impossible to drill holes of such depth as will insure adequate

strength in the attachment of the inlay to the tooth, without endangering the life of the pulp, devitalization may be demanded and should be resorted to when any question of doubt or uncertainty arises.

Fig. 438 A Fig. 438 B Fig. 439

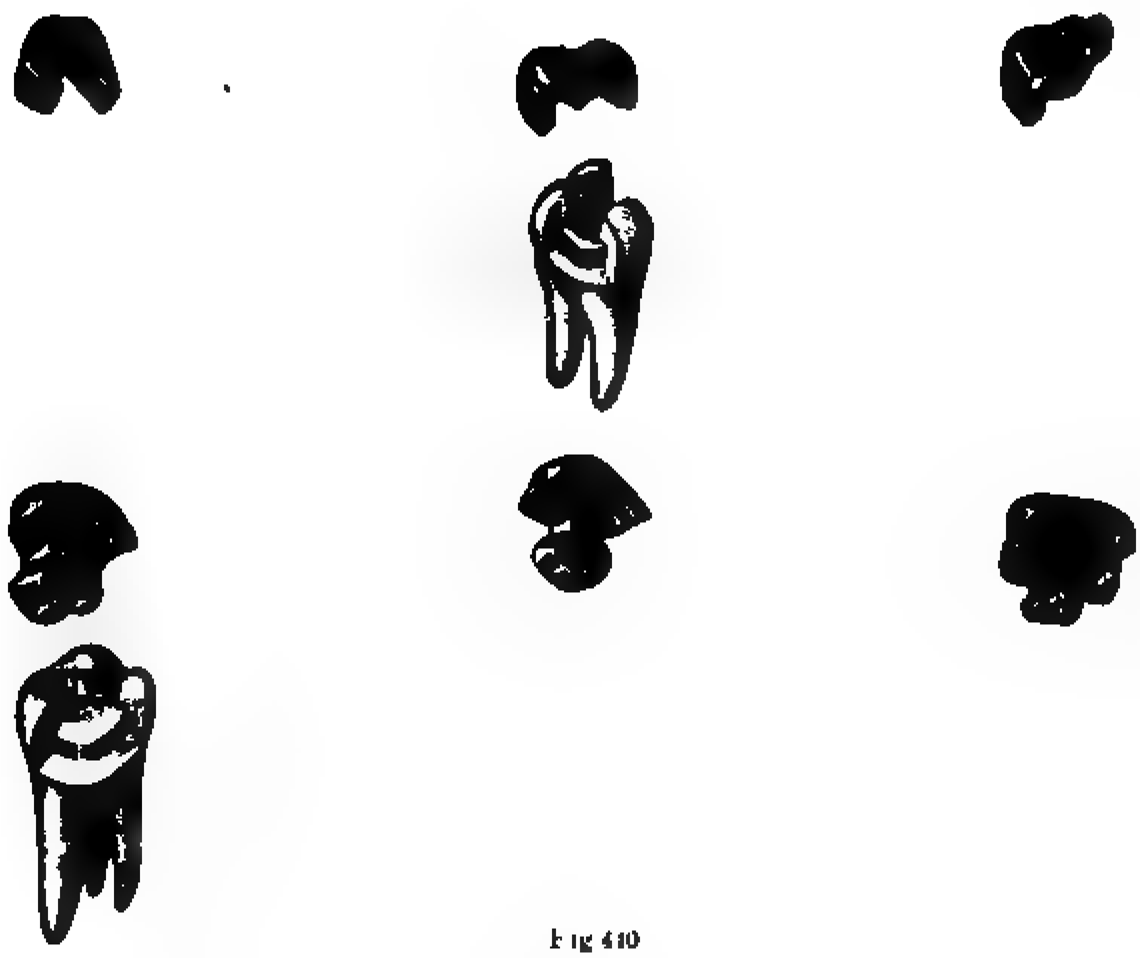

Fig. 440

Formation of Cavities in Posterior Teeth.

In the preparation of cavities in the posterior teeth for inlays which are to support bridgework, care must be exercised to break down and cut away all thin, frail walls; to form the cavity with a square, flat base, with the axial margins parallel or slightly diverging, and beveled to the extent of properly protecting the enamel rods. Extension for prevention must also be observed in following out

pits and fissures and particularly in cutting away the approximal surfaces to an extent which will afford freely exposed and self-cleansing margins.

This is especially necessary upon the approximal surface adjacent to the space where teeth are missing and against which the artificial bridge tooth is placed. The requirements of contact between the filling and the artificial tooth, and of strength in their subsequent attachment, at this point, demands that the cavity be sufficiently broad bucco-lingually to afford opportunity for this and at the same time allow a free exposure of the cervical, buccal and lingual margins. The outlines of the cavity and filling in Fig. 439 will illustrate the surface of the filling to which attachment of the adjacent artificial tooth should be made, and the extent to which the margins of the filling should be allowed to remain freely exposed.

Small stones of various sizes and shapes will be found extremely useful in this work, and when they may be used are much preferable to burs, and much easier for the patient.

Several typical types of cavity formation adapted to inlays, which are to be used as abutments for bridgework as applied to the posterior teeth, are illustrated in Fig. 440.

Formation of Cavities in Anterior Teeth.

If the casting process had made possible nothing more than the accurate adaptation of attachments to the natural crowns of anterior teeth, for the support of bridgework, it would still have filled a most important and useful mission. Prior to its advent a number of different methods of obtaining attachment were advocated and used, but because of the difficulty of securing any great or uniform degree of accuracy in their adaptation, natural teeth so used were often subsequently lost as a result of this deficiency.

Now, however, since the accurate adaptation of the inlay to the cavity is insured, the success and permanency of such attachments resolves itself into the simple question of the best type of cavity formation to be applied to the individual case, and this, of course, must necessarily vary with the conditions presenting.

In making attachment to upper incisors, where the tooth to be used stands free of adjacent teeth on each side, as indicated in Fig. 441, the cavity formed should involve both approximal surfaces and should extend across the incisal end, allowing as much of the labial plate of enamel to remain as is possible, but extending the approximal margins far enough labially to allow them to be free from contact of adjacent artificial teeth (Fig. 442). In such cases, when the pulp is vital, small pins may or may

not be indicated, but it is always safer to use them whenever there is any doubt, while in cases where the pulp has been or must be devitalized, the use of a pin is almost invariably indicated.

Where the attachment is to be made to a tooth having an adjacent natural tooth on one side of it as indicated in Fig. 443, only the ***approximal presenting toward the space*** and the ***lingual*** surfaces need be involved, but one or two pins should invariably be used, and the filling should extend far enough around the labial angle to be free from contact with artificial teeth, and all margins well defined (Fig. 444).

Fig. 441

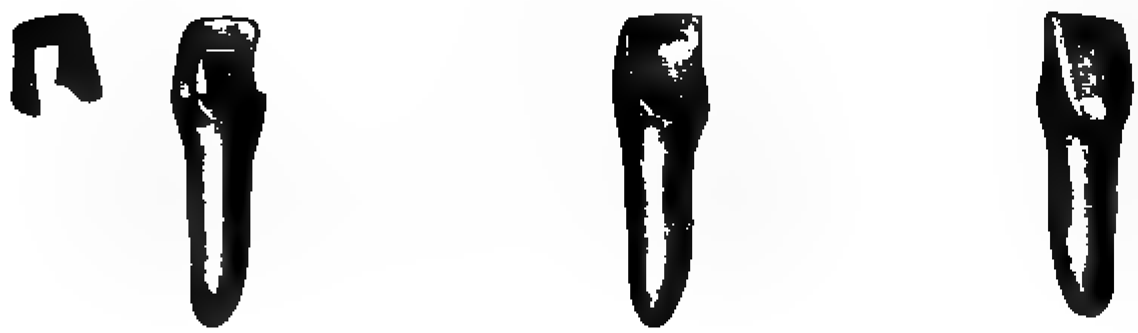

Fig. 442

Cavities in upper cuspids and bicuspids *which stand alone,* and where no decay is present, may be formed as for the ordinary "groove," or so-called Carmichael attachments (Fig. 445), while, if approximal cavities are present, the formation may be made along the same lines as for incisors.

As applied to the lower incisors, a secure attachment may be made by forming the cavity as outlined in Fig. 446, which, when a pin is used, insures a good adaptation, adequate strength, and practically no display of gold. In cases where some little display of gold may not be objectionable the cavity formation suggested by Dr. F. E. Roach will be found useful (Fig. 447). In this type of attachment it will be observed that the use of a pin will not be necessary.

Lower cuspids and bicuspids may be used much in the same manner as indicated for the upper teeth, but in *all* cases the cavities must be so formed as to have *definite margins* to which the inlay may be closely finished, and these margins should always be extended to an area which will be free from contact with adjacent artificial teeth and thus rendered self-cleansing.

Fig 443

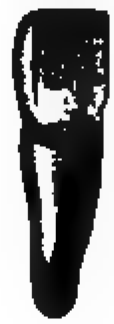

Fig 444

Technique.

When the cavity has been properly formed and all margins made well defined and smooth, the pins, if any are used, should then be placed in position in the tooth, having a little bead of wax melted around their previously notched surplus ends to form a head (but observing that their length does not interfere with the opposing teeth when in occlusion), and the wax filling then molded.

Making Wax Inlay.

For this purpose a *hard* wax, or one which is not affected by the body temperature, should *always* be used, for the reason that any wax which is sufficiently softened by the temperature of the body is not reliable, because if the wax inlay yields or draws to the slightest extent in removing from the cavity, accuracy of adaptation is thereby endangered, and no proof of the correctness of the cavity preparation obtains, both of which important features are insured by the use of a hard wax.

A piece of such wax of suitable size and shape should first be trimmed to follow the outlines of the cavity, thus insuring its readily finding its way to the most extreme cervical margin or margins, and at the same time allowing a liberal quantity of surplus.

When so trimmed the wax should then be heated to a *proper, uniform* and *workable* plasticity, which can be done best in hot water, or, possibly, by means of electricity, and the piece then forced to place with

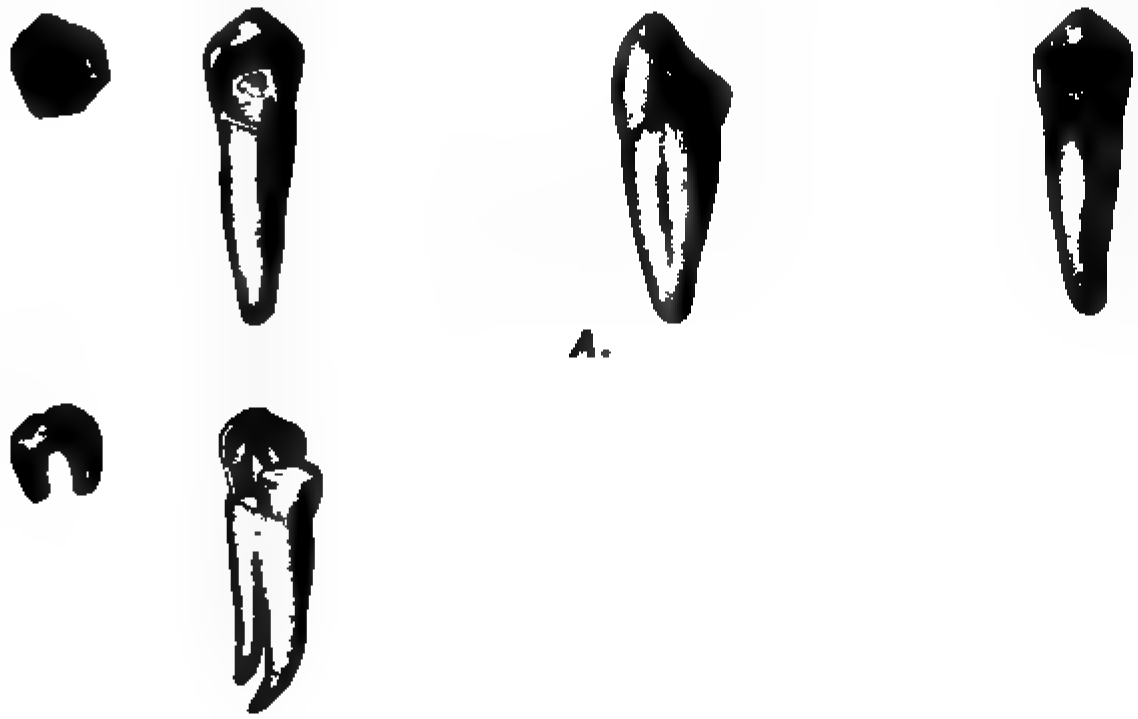

Fig 445 B

considerable pressure applied with the thumb. When so seated, the patient should be instructed to close firmly into it, and to exercise all of the mandibular movements, as in the act of mastication. When this has been observed the wax should be chilled with a spray of cold water and all of the surplus gradually and carefully trimmed away to the cavity margins with a warm sharp instrument. A thin ribbon separating file should then be carefully passed between it and the adjacent tooth, if one be present, and the filling gently removed by inserting a pointed instrument into the body of it at some favorable place, after which it should be finally trimmed and carved.

Any pins used will nearly always cling securely to the filling, but if they do not and are found to be loose, they should be lifted out of the wax and replaced in the tooth. The filling should then also be replaced and a hot pointed instrument inserted into the wax until the end of each pin is reached. This will melt the wax around the head of the pins and

thereby securely attach them, after which the filling should be polished smooth with a pledget of cotton dipped in liquid vaselin or glycerin The approximal surfaces may likewise be polished by using a strip of very thin tape previously saturated with either of the above and gently drawn backward and forward, much as a finishing strip is used. When the wax filling is thus finished, it should be carefully removed from the cavity and immediately invested. While some may prefer to place the

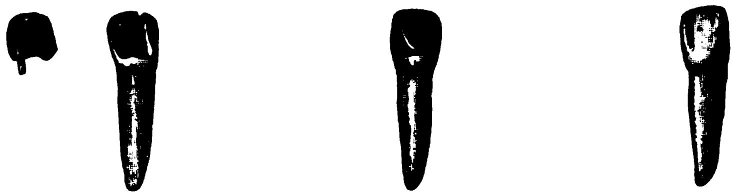

Fig. 446

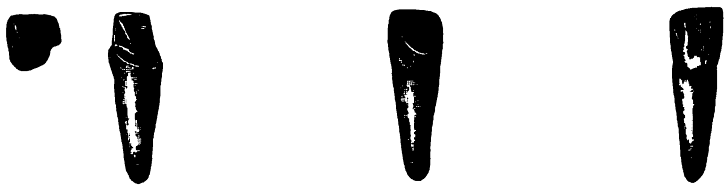

Fig. 447

wax filling in a small jar partially filled with water, and invest at a more convenient time, it is usually best to do this immediately as a precaution against any possible accident or change of form.

Investing. Prior to investing, the sprue-wire should be heated as hot as may be comfortably held in the fingers and then pressed into the inlay (Fig. 448) at some thick and favorable point, and held until cold. It should now be observed that the attachment of the inlay to the sprue-wire is securely made, in order that the possibility of its becoming loose and floating around in the investment may be precluded; it is then placed in position in the base of flask (Fig. 449).

An investment material which possesses the combined qualities of withstanding heat without change of form, of presenting a *smooth surface* and yet of such texture as will admit of the egress of air which is contained within the mold after the wax has been burned out, is

essential; and the accuracy of adaptation of the completed filling will largely increase in proportion as these qualities are present.

Such an investment should be mixed of a proper consistency, which may be obtained with uniformity by previously ascertaining the proper proportions each of investment material and water, by measurement. As

Fig. 448

Fig. 449

Fig. 450

Fig. 451

a working basis two parts of investment to one part of water, by weight, will usually afford a mix of the proper consistency, though this may vary with the different materials now in use. The "Ansco" apothecary scale No. 1 (Fig. 450) will answer nicely for weighing water and investment. When the proportions are thus properly weighed, they should then be thoroughly mixed, first with the spatula and then by rolling it in a thin layer around the inner surface of the bowl until all gases formed by the chemical reaction are liberated (Fig. 451).

This should be painted over the surfaces and into the pits and grooves of the wax pattern with a small brush, and then built up freely as indicated in Fig. 452. This primary coating of the pattern is essential with any investment material on the market, but not so great a mass can be built up with the Taggart investment, as with the others which stiffen quickly when mixed. The Taggart investment has the advantage of setting very slowly, although when it does begin to set the stiffening process is quite rapid. The fact that the Taggart material when mixed

Fig. 452 Fig 453

in right proportions is almost as liquid as milk, and then does not begin to stiffen for several minutes, allows time for thoroughly eradicating all air bubbles and gases by rotating in a bowl, as already described, or by shaking up and down in a large-mouthed bottle or other suitable receptacle. Dr. Taggart has introduced a special rotating mixing device which is very satisfactory. When thoroughly hardened, the base should be carefully detached, the sprue-wire heated and gently removed with heavy pliers (Fig. 453), and the flask then placed over the burner and the wax burned out.

Heating Up and Burning Out Wax.

Much of the success of the casting will depend upon properly heating up the flask and burning out the wax, and yet this must be done in such manner as will insure both, while at the same time conserving the integrity of the investment.

Where several cases are to be invested, heated up, and cast at the same time, it is always well to make some mark or letter on the under side of the investment in each flask, or with chalk on the flask ring, before heating, as a means of distinguishing them.

Just as soon as the investment has hardened and the base and sprue-wire have been removed, the flask should be placed over a very low flame and allowed to remain at such a temperature for five or ten minutes, or until all moisture in the investment has been converted into steam and evaporated.

A B

Fig. 454

The flame may then be slowly and gradually increased until its full volume has been reached, at which point the case should be allowed to remain until all evidences of burning wax or gases emanating therefrom, or of smoke, cease. Altogether this will usually require from twenty to thirty minutes, and the casting should never be attempted until such precautions have been observed, because any gases confined within the mold will cause imperfections in the casting.

When thus properly burned out, the case should be allowed to cool somewhat before casting, if possible, as experience seems to prove that the influence of heat and consequent expansion at the time of casting is more or less noticeable in the degree of accuracy in the adaptation, and this varies, of course, with the different investment materials.

Casting.

When the case has been properly burned out and allowed to cool as much as possible, or until only warm, the casting should then be made. All forms of inlay attachments for bridgework should be cast with an alloy of gold and platinum, or with about 22-karat gold, for the reason that pure gold is much too soft.

An alloy of five per cent. of platinum in pure gold, furnishes what appears to be the ideal combination for this purpose, although 22-karat gold, or coin gold, may be used. In the use of either, however, all parts of the work—inlays, crowns, backing, etc., should be cast with the same metal or alloy, in order that a uniform color may present throughout the finished piece.

It is also advisable to have a considerable surplus of gold for each casting, as undue economy in this connection may be the cause of innumerable failures which might otherwise be avoided, and as such surplus is not wasted, a liberal quantity should always be placed in the crucible.

The gold or alloy to be used should always be melted and refined previous to each casting. This may be easily and quickly accomplished by fusing the mass on a charcoal block and adding a small quantity of potassium nitrate (saltpetre) or borax, or a mixture of equal parts of both, to the fused metal, and failure to observe this precaution will usually result in a refractory or sluggish fusing, and may, consequently, give an imperfect casting.

Opening the "Bite."

In cases where the opening of the "bite" is indicated or demanded as a means of arresting the progress and influences of attrition, several inlays may be made in one piece, as illustrated in Fig. 454 In this procedure the occlusal surfaces need only be prepared to the extent of forming smooth definite marginal edges, and holes for the reception of one or two pins should be drilled into each tooth, observing that they are so placed as to be in parallel lines with each other and not to impinge too closely upon the pulps.

With pins made of about 20 gauge iridio-platinum wire, properly threaded, in position, the wax should be molded to the teeth, and to conform to the occlusion when held at the proper distance. This distance must previously be determined and temporarily sustained by an instrument or wedge on the opposite side of the mouth. When the wax is thus molded, it should be removed and carved and the piece then cast. A case of opening the bite to the extent of making opportunity for the complete restoration of the incisor teeth with porcelain crowns is illustrated in Fig. 455

Splinting Loose Teeth.

A similar procedure will often be found useful in splinting and properly restoring the occlusion of loose teeth, as illustrated in Fig. 456 the two inlays being made in one piece. or they could be made separately and subsequently soldered together.

Combination of Cast Gold and Porcelain Inlay.

In large approximo-occlusal cavities, whether the inlay is to be used as an attachment for bridge or not, it is often desirable to avoid a too conspicuous display of gold, and thus obtain a more esthetic effect. This may be easily accomplished by first making the wax filling and carving it as the requirements demand, and then cutting a "cavity" in the wax, and subsequently filling it with Jenkins's or Brewster's *low* fusing porcelain body after the filling

Fig. 455

has been cast. Such cavities may be cut in the wax, if it is hard, with Roach's "Suction Carver" or with a bur in the engine and sharp chisels, and if made of retentive form, the porcelain is securely anchored therein and will withstand the heat of soldering in the final assemblage of the filling to other parts of the bridge, if care is exercised in heating up and cooling off the piece (Fig. 457).

As there is considerable difference in the expansion and contraction of the larger mass of gold, as compared with the smaller quantity of porcelain, extreme care is also necessary to avoid the occurrence of checks or fractures in the latter after baking. If the cavity margins in the gold filling, however, are made perfectly smooth, if the porcelain is

not allowed to overlap upon them, and then, if the case is allowed to become cold in the muffle of the furnace after each fusing, and particularly after the last one, such mishaps may be avoided. In the event of an imperfection, the porcelain may be completely removed from the cavity in the gold by placing the filling in hydrofluoric acid, after which it may again be baked.

Casting to Surfaces of Metal.

In any of these procedures no apprehension need be felt as to whether the metal to be cast will alloy with or become securely attached to such bands or dowels, etc., as are used, for *if the latter are clean and free from oxidation* when the case is invested, and *if the metal is*

Fig. 456

Fig. 457

sufficiently fused when the casting is made, a physical union usually results. In the case of casting to the extreme ends of dowels, or small pins, or to the surfaces of clasps, attachments, etc., however, they should always be notched or roughened as a means of mechanically aiding in this attachment.

Use of Base Metals and Alloys

While an alloy of base metals compounded and advocated for all forms of cast work called "Acolite," "metalite," etc., or any of the better grades of amalgam or similar alloys may be used in the construction of crown and bridgework, with good results perhaps, the use of such low grade metal is not recommended, nor are they considered as possessing any possible advantage save that of pure but unwholesome economy.

Pin-Locked Inlays.

In some cases, more especially in the presence of living pulps, it is desirable to use a pin in connection with an inlay, in order to attain greater security. When two such abutment inlays are used and both carry pins, it is often found to be difficult to set the bridge after assembling the parts, because of the difficulty of having the pins parallel.

Moreover, it would be more desirable to have the pins at a tangent, if this were possible. For this reason Dr. H. N. Orr, of Chicago, and Dr. C. B. Reynolds, of Seattle, Wash., have conceived the idea of having the pins separable from the inlays, and so constructed that they may be inserted at the time of cementation.

The technique is as follows: After properly preparing the cavity, the wax inlay is made, and an iridio-platinum pin set in the usual way. The pin is then slightly warmed and removed, and in its place introduced a

Fig. 458

A B C D

Fig. 459 Fig. 460

carbon of the same gauge. These carbons are of various sizes, from 15 to 20 gauge, and may be threaded or roughened to make them remain more securely in the wax.

Fig. 458 represents two teeth prepared, and above them are two wax inlays with the carbons in place.

Fig. 459 at A and B, shows sections of the cavities, inlays and carbons, while at C and D, in Fig. 460 are seen occlusal surfaces and the openings for the carbons. When the inlay is cast, the carbon is removed, inserting in its place an iridio-platinum pin, and an extension into the tooth of the same gauge as the pin is then made. This is an advantage, as by this means the little hole which is to receive the pin may be drilled

into the tooth after the casting is made, and may be done very accurately.

Fig. 461 represents the finished bridge; the abutments with iridio-platinum pins showing at E and G and the dummy at F. In setting the

Fig 461

Fig 462

bridge, cement is also used for seating the pins, and these are driven securely into position, and the excess of pin is then ground flush with the occlusion.

It may be an advantage in some cases to thread the pin and then tap the hole through the inlay, and even into the tooth itself, thus making it possible to screw the pin into place.

Fig. 462 shows the bridge after it is set, the dotted lines indicating the seating of the inlays in the cavities and the position occupied by the pins.

Porcelain Crowns as Abutment Pieces.

In the use of any of the various forms of separable dowel crowns with cast bases as abutment pieces for bridgework, each crown to be so used should be first adapted directly to the root in the mouth in accordance with the requirements and in the manner indicated in connection with single crown work, and if there be more than one crown in the same case, each should be completed separately.

The only difference in the detail of procedure as outlined for single crowns, lies in the fact that the approximal surface of the porcelain crown presenting toward the space to be filled with artificial teeth, must be so grooved out or ground away as to permit the wax, and, subsequently, the cast base, to extend well down toward the occlusal or incisal end and beyond the contact point, as a means of affording sufficient surface of metal to insure ample strength in the subsequent attachment of the cast base to the adjacent portion of the bridge, with solder. (Fig. 463)

Where the root to be crowned stands alone, and artificial teeth are to be placed adjacent to it *on both sides,* then, of course, both approximal sides of the porcelain crown must be so ground for the same reason, as illustrated in Fig. 464

When thus ground and the wax base properly molded and trimmed, the sprue wire should be attached (Fig. 465) and the base cast, after which the porcelain should be temporarily placed in position, and the base finished to the point of polishing.

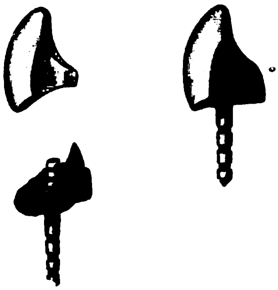

Fig. 463

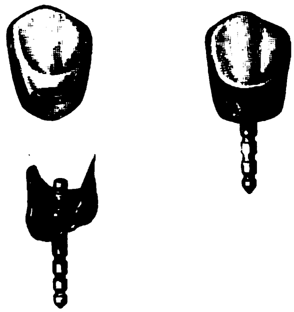

Fig. 464

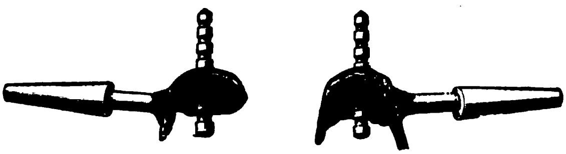

Fig. 465

Gold Crowns as Abutment Pieces.

When gold crowns are indicated as abutment pieces for fixed bridgework, the same general line of procedure suggested for separate crowns should be observed. Prior to this, however, it must also and always be noted that the approximal surfaces of the supporting root, or roots, are ground away until parallel with the long axis of the tooth, and with the other supporting teeth, in order to insure the ready adjustment of the completed fixture.

After the crown has been cast, it should be finished to the point of polishing and then fitted to position on the root.

"Bite" and Impression.

After all of the attachments or abutment pieces have thus been completed separately, they should be placed in position on the supporting teeth and the "bite" and impression taken.

Where inlays are used it is often well to primarily finish only the marginal edges, and then to allow a small projection of the "sprue" to remain (Fig. 466) until the "bite" and impression have been taken. Where this is possible, and particularly in flat-surface inlays for anterior teeth, the correct position of the inlay in the impression is thus more easily obtained and more securely sustained, and these are highly important features.

When porcelain crowns with cast bases are used, both the crown and its base should be in position on each root when the bite and impression are taken.

Fig 466

When each piece is thus finally adjusted to proper position on the supporting roots, the "bite" and impression should be taken, the former in wax and the latter always in plaster.

Models.

After carefully observing that each piece is forced well down in place in the impression and held with a small quantity of melted wax, if necessary, the impression should be properly varnished and filled. The model should invariably be made of a good strong investment material, because it then never becomes necessary to detach the abutment pieces therefrom in the subsequent final assemblage of the several parts by soldering.

When thus filled and separated, the "bite" should be adjusted and the case then mounted on the articulator.

Constructing Posterior Dummies.

After the models have been thus obtained, some suitable form of replaceable bridge tooth for bicuspids and molars, such as is made by the Consolidated Dental Mfg. Co. (see Fig. 434) or the Pennsylvania Dental Mfg. Co. (see Fig. 435), should be selected to meet the requirements of size and color and properly ground to the desired adjustment. It should then be observed that the approximal sides of each

porcelain tooth is sufficiently grooved out so as to admit of carrying the wax, and subsequently the gold backing, well over upon these surfaces, thus forming a finishing line for the backing, and more completely "boxing" up each tooth, thereby insuring a maximum of strength both in the backing and in its subsequent attachment to the abutment pieces with solder, and affording a cleaner interproximal space between each tooth (Fig. 467).

While any of the various makes of detachable dowel crowns may often be used in the same manner by grinding, these special bridge teeth

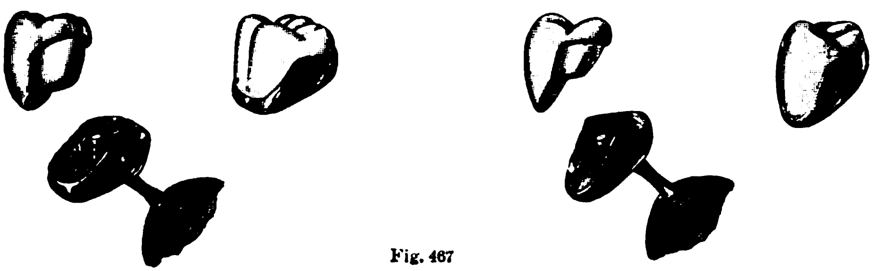

Fig. 467

are more universally applicable because of being thinner on the lingual sides, and consequently requiring less grinding upon these surfaces.

When ground to the proper and required adjustment to gum and occlusion, it should then be determined as to what form should be given to the lingual surface of the backing which is to support the porcelain teeth; whether it should taper from the cusps of the porcelain dummy to a small contact with the ridge at the neck (Fig. 468), or whether it should be broader and rest upon the gum in the form of a saddle (Fig. 469), and this is to be governed largely by the degree of absorption, the shape of the ridge, and the occlusion of the opposing teeth.

Saddle Formation.

If these latter conditions are favorable, the possibilities for securing an accurate adaptation of a narrow saddle to the gum often makes this type of construction preferable for the reason that the lingual contour of the intervening artificial teeth is thus restored, and if the saddle is *narrow and well adapted,* such surfaces are usually kept cleaner than are those where the lingual coutour is not restored and which are therefore more inaccessible.

Wax Backing.

As soon as this feature of construction has been determined and the teeth have been selected and ground, each tooth should first be separably backed up with wax. While the best results are to be obtained by using the pins which are especially made for some forms of these teeth because of their uniform size, it is possible, however, to make

Fig. 468

Fig. 469

a suitable pin of iridio-platinum wire about 14 gauge, or to make a wax pin to fit the hole in the tooth as a part of the backing, and this will, of course, be reproduced and subsequently become a part of the casting itself.

Fig. 470

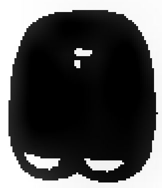

Fig. 471

Special Pins.

If the special pins are used, preference should be given to those made of iridio-platinum, gold and platinum, or clasp metal, for the reasons previously mentioned. In their use the lingual surface of each tooth should first be painted with glycerine or liquid vaseline, the pin properly fitted as to length and placed in position in the tooth (Fig. 470), and a suitable hard wax then melted around the exposed end of the pin and over the surface of the porcelain (Fig. 471).

Cast Pins.

In the absence of such, however, suitable pins may be easily made as a part of the casting by lubricating the interior of the hole in the crown and gently forcing the end of a small piece of warm hard wax, suitably shaped,

into it, and afterward pressing and molding the surplus end over the surface of the porcelain (Fig. 472).

When this has been done with each tooth, the surfaces of the model and attachments thereon should be similarly lubricated to prevent the wax

Fig. 472

from adhering thereto, and a piece of moderately soft prosthetic wax then molded to place. Each tooth with its wax backing should now be forced into this until assuming its proper relation to model and attachments, after which the wax should be carved to the desired outline.

Sectional Backings. While a separate backing may be made for each tooth in this manner, *and less display of gold always obtains as a result of backing each tooth separately,* still, in cases where some little gold in between the porcelain teeth *may not be objectionable,* it is unnecessary, as one investment and one casting will answer equally well for two, three or even four teeth in one piece, or for as many as may constitute one section of the bridge *between abutments* (Fig. 473). Such sections may be made in much less time, and will afford even better results in the finished piece, because of minimizing the number of pieces, and of thus involving less detail and requiring but a minimum of solder in the final assemblage.

After thus trimming and shaping the wax to meet all of the requirements of the finished backing, each porcelain tooth should be carefully detached, then replaced and removed several times, in order to obtain perfect freedom in their adjustment to the wax, and then laid aside until the casting has been made.

The sprue-wire should then be securely attached (Fig. 474), the case invested, and the casting made, after which it should be cleaned by placing in hydrofluoric or heated hydrochloric acid, until all particles of investment material have been removed. The acid is then neutralized by dipping the piece in a solution of soda, when each porcelain tooth should be

carefully fitted to place and the whole then finished with stones and disks, and fitted closely to the model.

The correct relation of each piece to the model should now be effected and sustained with hard wax, after which all of the porcelain teeth should be removed and the case invested for the final assemblage of the backing, or backings, to the abutment pieces.

Fig 473

The model having been made of investment material, it is now only necessary to first allow it to become thoroughly saturated with water, and then add to it a sufficient quantity of freshly mixed investment material of the same character, to sustain the relation of the parts during the heating up and soldering process, which, because of the absence of any porcelain, may be more or less quickly accomplished.

When assembled, the piece should again be treated to the acid bath, and when thoroughly clean and dry, the porcelain teeth should be cemented to place and the case afterward finally and nicely finished.

Use of Diatoric and Vulcanite Teeth.

The ordinary diatoric, or pinless, or even vulcanite teeth may also be used in similar manner. In the use of the former the lateral holes extending to the approximal surfaces, which are found in some makes, are an element of weakness, and since they can not be used in this work,

they should therefore be filled with low-fusing porcelain body before being ground to the proper adjustment.

Vulcanite teeth may also be successfully used by temporarily enlarging the body of the pins to the same diameter of their heads with wax or cement, and then lubricating the whole and adapting wax backings. When

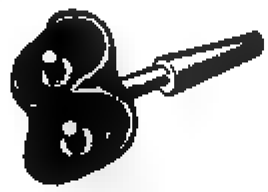

Fig 474

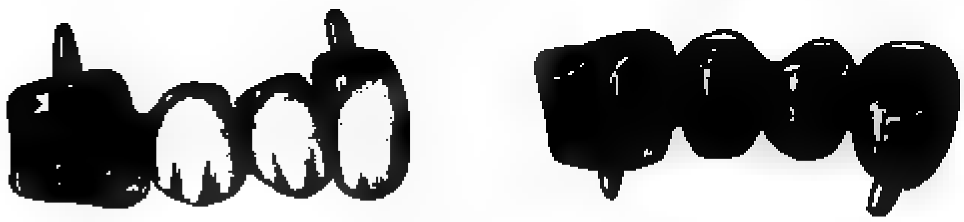

Fig 475

the backing has been cast and assembled to the other parts of the bridge, the material used to temporarily enlarge the pins for the purpose of admitting of the detachment of the wax backing may be removed and the tooth or teeth then cemented to place. Or small platinum tubes with a soldered joint and one end closed up, and of a proper size to fit over each pin, may be made, placed in position, the wax backing securely attached to them, and the casting made over and around them.

Use of Ordinary Long Pin Facings.

Ordinary long pin flat-back facings may also be used, either as previously suggested in connection with single crown work (see Fig. 415), or in the manner described as applying to the use of vulcanite teeth, and the entire occlusal as well as lingual surfaces properly formed in wax and subsequently reproduced in gold (Fig. 475).

In cases of very close "bites" combined with a strong occlusion, or a powerful occlusal stress, or where the cosmetic requirements are not a prominent factor, this type of construction may occasionally be indicated.

While any of these latter forms of teeth may also be used by casting directly to them, this procedure is not recommended for the reasons previously mentioned, and particularly when gold or any of its alloys is used in the construction of the work.

Gold Dummies. In many instances where the cosmetic requirements do not demand, and where the exceedingly powerful stress of occlusion does not indicate the use of porcelain, all-gold dummies may be easily made in single form or in sections, by molding wax to fit the space, the model, and the occlusion (Fig. 476) on the articulator and reproducing it by casting, and this pro-

Fig. 476

Fig. 477

cedure will be found particularly useful in the construction of so-called "self-cleansing" bridges, or where only the occlusal surfaces are necessary (Fig. 477).

Constructing Anterior "Dummies."

In the construction of bridges which involve the replacement of anterior teeth, the abutment-pieces should be made separately, as previously indicated, and when all are finished should be placed in position on the supporting teeth or roots, and the "bite" and impression taken. The model should then be made of investment material, the bite adjusted and the case mounted on the articular. A typical case, where the four incisors are supplied by attachment to the cuspid roots in the form of separable dowel crowns with cast bases, is illustrated in Fig. 478.

The type of porcelain tooth which seems best adapted to the requirements of the case at hand should now be selected and ground to fit the model and to otherwise conform to the requirements. Wherever possible, some form of replaceable tooth or facing should be given the preference

for the reasons mentioned, though ordinary facings may, of course, be used, and backed up either in the usual manner or by casting.

Replaceable Facings. The special form of facing with separate pins will be found to be more or less universally applicable, and when this type is available, suitable ones should be selected and ground to the proper adaptation, with a slight bevel at the incisal edge.

Fig. 478

Fig. 479

The lingual surfaces should then be coated with glycerin or oil, the pins placed in position, and *hard* wax, such as is used for inlays melted and run over the entire surface until a thin backing is thus formed.

The model should then be varnished with shellac and then with glycerin or oil, a rim of fairly soft prosthetic wax molded and attached to it with a hot instrument, and each tooth with its pins and hard wax backing then forced to place in this. When the proper and desired adjustment has been secured and sustained by melting the softer wax, the entire section of backings should be formed and carved to the requirements.

Each facing should now be gently lifted off (Fig. 479) and the sprue-wire attached at a favorable point somewhere near the center, and the piece invested and cast.

One sprue-wire is all that will usually be found necessary for casting the backings of three or even four teeth, and it is seldom that any one section will include more than this number between abutment-pieces. In the event of larger sections, however, provision should be made for additional "gates," such as is indicated for large castings, and which will be described in connection with "removable" fixtures.

When the section has been cast and then thoroughly cleaned in acid, it should be finished to the point of polishing, in which it is necessary to observe that any small projections or nodules of gold which might interfere with the proper adjustment of the facings are removed with a sharp

Fig 480

blade, or with a bur in the engine. These are sometimes present as a result of too coarse or improperly manipulated investment materials, and can only be avoided by observing the technique in this particular, as previously outlined.

The section with the facings temporarily in position should now be fitted to place on the model and very slightly imbedded therein by first marking the outline of the casting in its proper relations, then removing it and trimming off the surface of the model within this outline to a limited but uniform extent, averaging, perhaps, the thickness of a piece of thin blotting-paper (Fig. 480).

The piece should then be again placed in position and its relation to the model and abutment-pieces securely sustained with hard wax, after which the facings should be carefully removed and the case then invested as suggested in connection with posterior dummies.

When the assemblage has been made with just enough 22-karat or 20-karat solder to fill the immediate joints between the section, or between the sections and the abutment-pieces, the case should be again cleaned in acid, both it and the facings dried with warm air, and the latter cemented to position with a cement closely approximating the color of the teeth. As

soon as the cement has thoroughly crystallized, the piece should then be finished, polished and mounted.

The selection and grinding of duplicate facings at the time of constructing the piece and their preservation is a valuable safeguard at all times, but if this is not observed the make, color and mold of the tooth used should always be recorded.

Replaceable Crowns Used as Dummies.

Wherever the extent of absorption, combined with favorable occlusion will admit of the use of any of the various forms of separable dowel crowns instead of facings, their use offers the additional advantages of lingual contour and absence of metal backing extending to

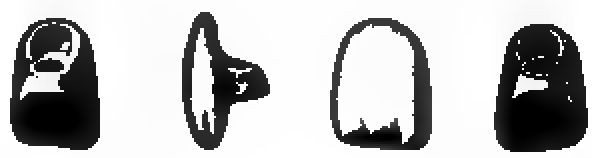

Fig. 481

the incisal end, thus affording increased artistic and esthetic possibilities. They are applicable, however, only to such cases as present adequate space, or to those cases where a saddle resting upon the gum is indicated and may be used to support them.

When used in connection with a saddle, some display of gold between the necks of the crowns is unavoidable, and where this is objectionable such a type of construction is not indicated. Any considerable display of metal, however, may be overcome by grinding a groove in the approximal surfaces of each crown, as recommended in connection with the construction of porcelain crowns with cast bases as abutment-pieces for fixed bridgework, and grinding the lingual surfaces much shorter than the labial, thus admitting of the formation of a backing instead of a saddle, and insuring strength in their assemblage (Fig. 481).

Ordinary Facings.

The ordinary long pin facings now in common use may also be used in replaceable form and in connection with a cast backing, either separately or in sections, in exactly the same manner as suggested in single crown work.

In the use of these facings, however, and when the backing is to be cast, the best results are usually to be obtained by *first adapting a thin backing of pure gold to each facing and casting direct to this,* by using graphite pins (Fig. 482), and the wax backings and castings may be made in sections, including as many teeth as are used between the abutment-pieces, or each one may be made separately, and subsequently united with solder.

The only objection to this type of facing used in this manner lies in the necessary thickness of the backing immediately surrounding the pins, though this may be somewhat reduced by shortening them. Facings so used afford the advantages of better protection against fracture, either in

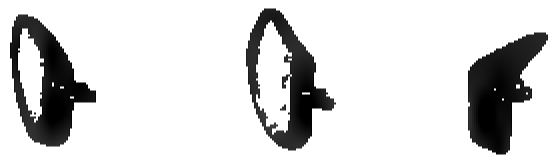

Fig. 483

the assemblage by soldering, or in the mouth; of replacement in the event of breaking; and of preservation of color because of being attached with cement; while a cast backing, as compared with one made by burnishing or swaging, affords the advantages of greater and more uniform strength combined with better form, or increased artistic possibilities.

Steele's or Evslin's Replaceable Facings.

Steele's replaceable facings may also be used in similar manner by first grinding them to meet the requirements and then burnishing and trimming the backings which accompany them to the proper adaptation. Facings and backings should then be assembled on the model, the backings waxed together, and additional wax then added to permit of reinforcing and carving to the desired form, after which the facings may be removed and the section cast all in one piece and directly against the thin backings. Where very thin facings are demanded, this type of dummy or the one designed by Dr. Evslin will be found more or less universally applicable to the six or eight anterior teeth, and may be thus used to good advantage, though, because of the slot through the center, neither is regarded as being as strong a facing as the one suggested by the author.

Typical Cases.

A typical illustration of the possibilities of the casting process as applied to crown and bridgework, and embracing *esthetic* features, combined with a degree of accuracy of adaptation with a maximum of strength and a minimum display of metal, together with the indisputable and incalculable advantages to be obtained by the use of detachable or replaceable porcelain crowns and facings in a manner heretofore and other-

a

b

c

Fig. 483

wise impossible, at least to a degree which puts previous efforts to shame, is evidenced in the following more or less extensive and interesting case.

The three views of the casts designated as Fig. 483 A, B and C, show the case as it presented, and illustrate a very unusual degree of under-development of the dental arches and teeth, in the mouth of a young lady, eighteen years of age, who was otherwise perfectly developed.

The temporary molars on each side and in both arches had been

retained, occupying the space of the bicuspids which had never erupted; no lower lateral incisors, nor any of the second or third molars in either arch had made their appearance, and the crowns of the sixth-year molars, cuspids and incisors, which had erupted, were malformed and dwarfed to such an extent that their occlusion brought the lower jaw into such close proximity with the nose as to completely destroy all of the lines which give harmony and expression to the lower third of the face.

As may be expected, this condition resulted in a degree of disfigurement such as is usually observed in the edentulous mouth of old age, but such as would be embarrassing even to middle age, must less to youth and beauty.

In studying the case with a view to ascertaining the best means of bringing about such changes as the restoration of the features of the face demanded, it seemed, at first, necessary to resort to orthodontia, and to so change the position of the roots of the teeth as to permanently modify or relieve the disfigurement.

A series of skiagraphs showed the roots of these teeth to be abnormally large and well-developed and gave no evidence of the hidden presence of any of the missing teeth, not even the third molars.

Several consultations with prominent orthodontists, and a careful study of reconstructed models, measurements, etc., together with the age of the patient and the anxiety to have something done in the shortest possible space of time finally led to an abandonment of the idea of regulating, and to the conclusion that the best results were to be obtained by removing the temporary molars, which were somewhat loose and more or less decayed, opening the bite to the required distance by lengthening the sixth-year molars, and replacing the temporary molars and all of the dwarfed crowns of the incisors and cuspids with artificial ones of proper prominence and proportionate size.

In accomplishing this the temporary molars were, of course, first removed. The "bite" was then opened to the required extent, which was a full half inch, by elongating the upper right sixth-year molar with a cast gold crown to a length corresponding with the desired length of the upper incisors, and then building up the lower molar with an inlay made to occlude with this and to sustain the new closure at the desired point. These two pieces, opened the bite to a degree demanded by the desired restoration of the features of the face, and sustained this closure during the construction of all of the work.

A full crown was used on the upper molar, and an inlay on the

lower only because each seemed best adapted to the respective tooth. Both teeth were devitalized, however, and the inlay carried a good-sized dowel extending well down into the pulp-chamber.

As soon as these were completed, the same procedure was followed on the opposite side of the mouth, and when the four pieces were finished they were temporarily placed in position on the supporting teeth, and impressions taken in plaster, after a bite in wax had been obtained. Casts were then made and mounted upon the articulator.

These casts were used only for the purpose of selecting detachable porcelain crowns of suitable size and shape to fill the space and to meet the esthetic requirements—a very important procedure where a definite space is to be filled. and, after cutting off the plaster teeth, these were selected in pairs, or with a duplicate for each.

By this means the position of the right upper cuspid crown in its relation to the supporting root was correctly ascertained, and the natural crown was then excised, the basal end of the root suitably prepared, and the porcelain crown ground and otherwise adapted to the proper adjustment in the mouth, in which procedure the duplicate crown on the model may be used as a guide, and will materially facilitate accuracy.

A disc of 36-gauge pure gold was then burnished to the root, the dowel adjusted, and soldered thereto, and the base then molded in wax, and cast, as previously described. The use of the disc of pure gold facilitates the molding of the wax base to crown, root and dowel, and insures a close adaptation to the end of the root, and, if the crown has been ground to a close joint with the labial, or buccal, surface of the root, the display of any metal at this point in the finished crown is eliminated.

When the base had been cast, this crown was then finished up to the point of cementing the porcelain to the base. Both the base and porcelain crown were then placed in position on the root, together with the gold crown for the molar, an impression taken in plaster, and the cast made of investment material.

The bicuspid dummy which was to take the place of the temporary molars removed, the space having been diminished in consequence of the size of the cuspid crown, was then ground to the proper adjustment on this model, a wax backing made for it, and the casting then made. After casting the backing, it was finished and assembled directly on this model by sustaining its position with hard wax, removing the two porcelain crowns, adding a small quantity of investment material sufficient only to hold the parts together, and soldering.

When this piece, comprising the molar crown, the cuspid crown and the intervening bicuspid dummy, was roughly finished, the *duplicate* porcelain crowns were then ground to *fit* their respective backings, after

which they were numbered *"one"* and *"two"* with ink, and then laid aside. The original crowns were now cemented to place and the piece finished and polished.

The lower bridge on this same side, which carried two bicuspids dummies, each backed separately, was then made in identically the same manner, and constructed to occlude properly with the upper one. When these were completed, the final mounting was deferred until the two bridges on the opposite side had been completed, and these were built in exactly the same manner, and made with the finished bridges for the opposite side temporarily in position, in order to conform to the same occlusion.

When the four bridges were completed they were all permanently mounted at the same sitting, thus establishing the new closure of the mandible with the resultant stress assumed bv teeth on both sides of the

arch, therehy avoiding the soreness and discomfiture which might be caused by throwing the stress upon only a few teeth at first.

With the four bridges permanently mounted, the four upper incisor crowns were then made, following the same technique, but making the two laterals first, and then the centrals, in order that the proper division of the space may be observed, and in each case grinding and numbering the duplicates before cementing the original crowns to place on their respective bases.

When these were finished and mounted, porcelain jacket crowns were then made for the lower central incisors. These were made in preference to dowel crowns, for the reason that the shape and size of these teeth seemed more favorable to the adjustment of a telescoping instead of a dowel crown.

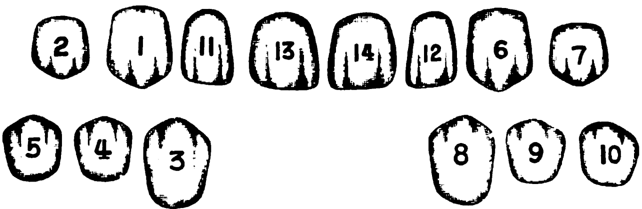

Fig. 485

In this connection it will be observed that no effort was made to supply lower lateral incisors, it being previously determined by measurement that central incisors and cuspids of a size suitable to fill the space would be more proportionate than if the size of these teeth hau been sufficiently reduced to make accommodation for four incisors. In other words, two teeth of proportionate size would look better than fou small ones.

The results obtained, as illustrated in Fig. 484, wrought a most wonderul improvement in the features of the patient, and when this consideration is combined with the fact that absolutely no gold was visible anywhere anterior to the sixth-year molars, and that the patient carries with her a duplicate crown for every tooth (Fig. 485), excepting the two jacket crowns on the lower incisors, numbered also on a record chart which is given to the patient, so that any dentist anywhere may readily and easily take care of her in case of accident or emergency, it is apparent that such results approach closely to the *ideal,* and indicate and emphasize the possibilities of modern methods.

The object of placing a number on each duplicate tooth, and also giving the patient a chart similarly numbered, is to enable any dentist

FIG. 1.

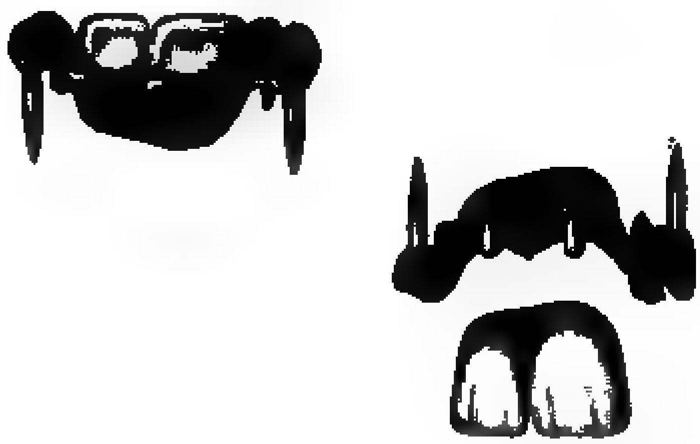

FIG. 2.

FIG. 3.

PLATE D.

to whom the patient might be obliged to apply in an emergency, to be able to identify the duplicate for the one that may have been broken. Thus the duplicates in the above case were numbered in the order in which the originals were used, and these numbered duplicates were given to the patient. A regular chart, such as is commonly used in dental account books, was then numbered similarly, and also given to the patient. Thus any dentist called upon to replace, let us say the left upper cuspid, by consulting the chart would note that such tooth was numbered "6," and he would then use duplicate number "6" in making the repair.

This method of giving the patient accurately numbered duplicates, and a similarly numbered chart, is quite advantageous where many teeth are placed in one mouth, for it must be remembered that there are four cuspids and eight bicuspids, which, in many instances, might be mistaken the one for another. Even molars are not always positively recognizable.

Smaller Cases.

Further evidence of the value of the casting process, as applied to the construction of "fixed" bridgework, of a more or less typical character, and in which inlays are used as attachments, is illustrated in the following cases:

Plate D, Fig. 1, shows the application of inlays involving only the lingual surfaces of the central incisor and cuspid, without devitalizing the pulp, and which are used to support a missing lateral incisor.

This particular type of cavity preparation is adapted more generally to those cases where the supporting teeth have pronounced "bell-shape" crowns, where large interproximal spaces admit of keeping their approximal surfaces clean, and where the conservation of the pulp is desired. The use of small pins, however, is regarded as being essential to the secure fixation of this type of anchorage.

Plate D, Fig. 2, shows the application of inlays with large posts extending well into the canals of teeth which have been devitalized, and in which the cavity preparation has been made to involve the approximal surfaces of each tooth, thereby bringing the margins of the inlay to immune or self-cleansing areas. This type of cavity preparation is generally regarded as being the best practice, wherever more than one tooth is to be supplied, and devitalization is possible.

It will also be observed that the extent of absorption in this case demanded considerable restoration, and that this was obtained by making a gum block of two separable dowel crowns, and subsequently cementing them to the cast saddle after it had been soldered to the inlays. Such

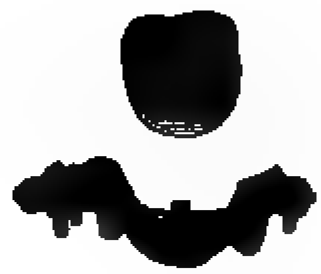

FIG. 1.

FIG. 2.

PLATE E.

blocks may be easily made by selecting and grinding the crowns, burnishing platinum foil to the model, filling in between the crowns and the foil with high fusing body, and subsequently finishing with gum enamel.

Plate D, Fig. 3, illustrates a more extensive case of the same kind, but in which ordinary long-pin, flat-back facings were used in making the gum block. The making of the block, with provision for its subsequent attachment to the supporting inlays, was accomplished by first soldering the facings to a round iridio-platinum wire, 14 gauge, bent to fit around the curvature of the teeth, immediately under the pins, and with each end flattened and adapted to a close contact with the inlays. When so assembled, platinum foil was then burnished to the model, and the desired restoration built up with porcelain body. When the block was completed, it was placed in position on the model and invested, and the projecting, flattened ends of the iridio-platinum wire were then soldered to the inlays with 22-karat solder.

Plate E, Fig. 1, illustrates a typical method of supplying a missing sixth-year molar, where the cosmetic requirements call for the use of a full-size tooth, such as is usually demanded in the upper arch, and where a Davis or other separable dowel crown with a cast backing will afford the strongest and most artistic results possible. The same type of construction is also applicable to cases where two or even three teeth are demanded.

Plate E, Fig. 2, illustrates the same type of work applied to the lower jaw, where the cosmetic requirements are not so great, and where the restoration of the occlusal surface is all that is demanded.

This type of construction is generally applicable to one or more teeth in the lower arch, wherever the extent of absorption is sufficient to allow ample opportunity for keeping all surfaces clean, and where the display of gold occlusal surfaces is not conspicuous or objectionable.

Removable Bridgework and Partial Dentures.

CHAPTER XXX.

Indications. Anchorage or Attachments: Use of Clasps, Typical Application, Vulcanite Bases, Gold Bases, Cast Clasps, Clasping Porcelain Crowns, Clasping Natural Crowns. Use of Roach Attachments: In Connection with Inlays, In Connection with Porcelain Crowns, Precautions. Construction of Fixtures: Small Cases, Investing and Casting. Larger Cases: Extension Bar Bridges, Overcoming Simple Difficulties, Assembled Abutment Pieces. Removable Attachments in Combination with Porcelain.

Whatever the casting process may have done in the way of revolutionizing and simplifying the methods of procedure formerly observed in the filling of teeth, and in the construction of single crowns and fixed bridges, and however applicable it may be to this line of work, it is also equally applicable to and especially valuable and useful in the construction of removable bridgework, and all forms of partial dentures—where the same accuracy of adaptation and the same requirements of strength are demanded, and where the fixtures are usually and necessarily larger.

While no class of work will, perhaps, ever take the place of well-adapted and properly constructed "fixed" bridgework, or answer the same purposes, yet, since the success of such work primarily depends entirely upon the *favorable location and stability* of the supporting teeth or roots, some form of removable structures will always be indicated in that large percentage of cases where these combined essentials do not present.

Indications. Hence, "fixed" bridgework is indicated only in those cases where the *position* and *stability* of the supporting teeth are favorable, while in *all cases* where these primary requirements do not present, ***removable structures*** are not only ***indicated,*** but ***demanded.***

The successful application of removal structures, while not depending so much upon the favorable position or location of the supporting teeth in the arch—for the reason that much of the stability of the structure is assumed by contact of the base of the piece with the contiguous soft tissues—will necessarily depend largely upon the manner in which fixation, attachment or anchorage to the supporting teeth is obtained.

Thus the application of removable structures which are sustained by some mechanical means, instead of by simple contact with the soft tissues, such as a so-called partial "plate," resolves itself largely, first, into a question of anchorage to the remaining or supporting teeth, and, second, into the best method of obtaining the required accuracy of adaptation and strength in the construction of the fixtures; in both of which instances the casting process affords an almost unlimited range of application and a wide field of possibilities.

Anchorage or Attachments.

The question of the best or most universally applicable means of obtaining anchorage for removable structures of any type is one which will probably always depend much upon personal equation or individual preference, but while the casting process is alike applicable to any and all of the various forms of attachments, it is particularly applicable to the construction and use of *clasps* of various forms, and to the use of the "Roach," "Morgan," of any of the other similar designs now manufactured for this purpose; and these two general types of anchorage afford a very wide range of application and general usefulness when combined with the facilities and advantages now offered by the casting process.

Use of Clasps. As applied to *molars* and *bicuspids*, clasps must always be regarded as a most useful and reliable means of obtaining attachment for the anchorage of all forms of removable bridges or partial dentures. When their use is confined to these teeth, when they are of favorable shape and position in the arch, and when they are made in accordance with the general requirements of a clasp, as previously detailed, and made of an alloy possessing toughness and resiliency—such as *rolled* or "plate" *clasp-metal,"* and properly adapted to the supporting tooth, with an adequate provision against the possibility of subsequent settlement, they afford, perhaps, the most simple, secure, permanent and universally applicable means of obtaining attachment to these particular teeth, which is now at our command.

It must be remembered, however, that because of the injury to the natural crowns of teeth likely to result from the influences of mechanical abrasion or attrition, the best and most permanent results are to be obtained by first placing artificial crowns upon the roots of the supporting teeth, and adapting the clasps to them. Such crowns may be made of gold, or of porcelain if the cosmetic requirements demand, but it should always be observed that the shape given to them is made favorable to the subsequent adaptation of the clasp.

An occlusal rest or some other means of preventing any great degree of subsequent settlement in the mouth, however must always be observed, for if such provision is not made, the case will continue to settle as absorption progresses, with the result that the occlusal relationship and usefulness of the piece may be destroyed, and much discomfiture and

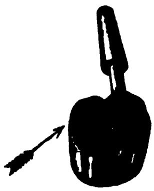

Fig. 486

injury to the soft tissues surrounding the supporting teeth may be caused by impingement of the clasps upon them.

Typical Application. Perhaps the most simple, practical and useful application of clasps to gold crowns may be made by making the crown with straight or parallel sides and cutting a seat in the occlusal surface of the wax of proportions sufficient to accommodate an occlusal rest, just before investing and casting (Fig. 486).

When the crown has been cast (Fig. 487) it should then be finished and mounted. The clasp should now be made of 26-gauge clasp-metal and trimmed and adapted to the crown directly in the mouth, after which a plaster impression should be taken with the clasp, or clasps, in place, and the model made after carefully ascertaining that the clasp occupies its proper position in the impression. If the case is to be made of *vulcanite*, the model may be of *plaster*, but if the clasp is to be

attached to a *gold* or *platinum base* by means of *soldering*, the model should be made of investment material.

Vulcanite Bases.

Where vulcanite is to be used as a base, the clasp should first be detached from the model, exercising care so as not to break off the plaster tooth supporting it, and when thus loosened and then readjusted to place, a piece of 17 or 18 gauge round iridio-platinum wire should be adapted to the broad surface of the clasp with the occlusal end bent at a right angle and

Fig. 488

Fig. 489

Fig. 490

Fig. 491

fitted into the seat in the plaster tooth, corresponding to the same accommodation in the crown, and the other end formed into a loop of suitable size to insure secure attachment to the vulcanite (Fig. 488).

When so fitted the desired relation of the wire to the clasp should be sustained with hard wax, the whole gently lifted off of the model, invested and soldered, after which it may be replaced upon the model (Fig. 489), and the case completed in the usual manner.

Gold Bases.

Where a gold base is used, the base should be made as soon as the investment material model, with the clasp in place, has been obtained. A piece of 17- or 18-gauge round iridio-platinum wire should then be bent and fitted

into the seat, and to a close contact with the flat surface of the clasp, and to the surface of the gold base (Fig. 490). It may then be soldered to both directly upon the model (Fig. 491).

A typical case showing the application of clasps to gold crowns on the two lower second bicuspids is illustrated in Fig. 492.

Another very useful application of clasps to gold crowns is to be obtained by first making the crown with a *narrow* band, and forming and shaping it to meet the other requirements with wax, after which a shoulder should be trimmed away in the wax to follow and accommodate the desired outline and form of the clasp. The crown should then be invested and cast, after which 26-gauge clasp-metal may be fitted to place on the crown, and subsequently attached to the base in the manner indicated above. Or the clasp may first be made in wax to fit the groove in the crown, and this subsequently cast (Fig. 493).

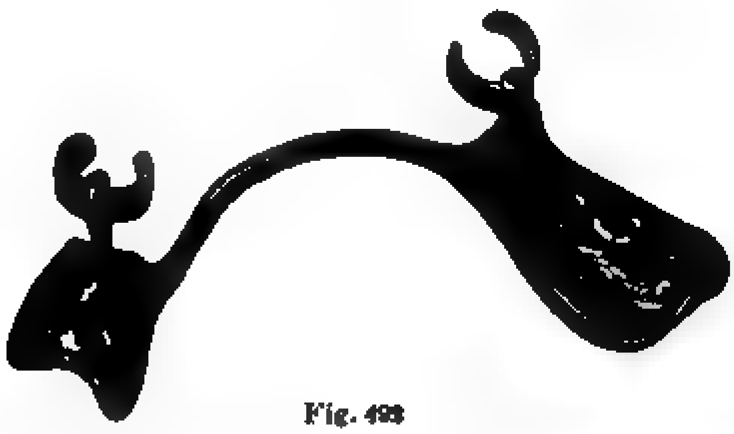

Fig. 492

Fig. 493

Cast Clasps.

The casting of clasps, however, is not recommended, for the reason that even though clasp-metal be used for the purpose, the process of casting it seems to completely destroy its resiliency—the very quality which a clasp *must* possess—and causes it to become very brittle. Hence, clasps or any other parts where toughness, strength and springiness are demanded should always be made of *rolled* clasp-metal alloy.

Clasping Porcelain Crowns.

These same principles are equally applicable to the adaptation of clasps to porcelain crowns in all cases where porcelain is demanded for cosmetic reasons, and where the crown may be so shaped or ground as to afford similar opportunity.

Clasping Natural Crowns.

Wherever the adaptation of the clasp directly to the natural crown of a tooth may seem to be indicated or warrantable—which is not often, except, perhaps in old age—the same general principles should always be observed, and in cases where the placing of an occlusal rest, as indicated, may interfere with the occlusion, the tooth to be clasped should be ground until suitable accommodation is thereby obtained.

Use of "Roach" Attachments.

If clasps are especially applicable to the molar teeth, and occasionally to the bicuspids, and particularly when they may be used in connection with gold crowns, the ball and telescoping tube attachments designed by Dr. F. E. Roach are equally applicable and useful as applied to the ten anterior teeth, and especially to the *six* anterior teeth, where they may be used in connection with inlays or porcelain crowns, and where clasps of any form are impracticable, owing to the unfavorable shape of these teeth.

While the two parts may be interchangeably used, it is usually best to attach the *ball* to the supporting tooth and the *tube* to the removable part of the fixture, as this procedure more readily admits of subsequent tightening in the event of wearing loose, which contingency is more or less inevitable.

In Connection with Inlays.

When it is desirable to use the Roach attachment in connection with an inlay, the cavity must be prepared so that the inlay will involve or include sufficient surface and thickness to admit of placing the ball part of the attachment in the most favorable position to afford secure attachment, and at the same time offer opportunity for the proper adjustment of the adjacent artificial tooth to be supplied, which always demands that it be placed *well to the lingual surface,* and all inlays used to support this or any other type of attachment for removable work must have one or more pins in them.

When the cavity has been so formed and the wax filling made, about one-half of the shank projecting from the ball should usually be cut off,

the remaining end then grooved or roughened, the ball grasped with small pliers, slightly heated, and the small surplus end then forced into the wax filling to the proper depth, and at the proper point. After observing that this attachment to the wax has been made secure, the sprue-wire should then be likewise attached at a favorable point (Fig. 494 A), and the filling then invested and cast (Fig. 494 B).

By this means the attachment becomes an integral part of the filling and its position in relation to the filling, together with a greater degree of strength than is usually obtained by soldering, is facilitated and insured.

a *b*

Fig 494

Fig. 495

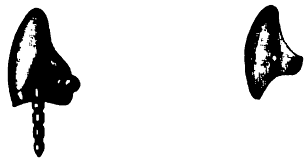

Fig. 496

In Connection with Porcelain Crowns.

Where the attachment is to be used in connection with porcelain crowns with cast bases, such as are indicated and now more or less generally used in restoring the ten anterior teeth, a narrow, well-adapted band should invariably be used, and the lingual or approximal surfaces of the porcelain tooth or crown must be so ground as to afford sufficient space between it and the root to allow of a thickness of wax which will accommodate the attachment of the ball at the proper point. This part of the attachment should now be prepared (as indicated for inlays), and then securely attached to the wax while the crown is in position, after which the sprue-wire may be attached, the porcelain removed (Fig. 495), and the base invested and cast (Fig. 496).

Precautions.

In thus casting directly to the attachment it must be observed that the end is first properly notched or roughened and then that it is forced or buried into the wax to an extent which will insure strength in the sub-

sequent union of the attachment and gold used in casting. It is also well to paint with whiting the surface of the ball up to and including the slight groove into which the tube fits before investing, as such a precaution precludes the possibility of increasing the size of the ball by the addition of any of the metal used in casting, or of fusing it during this process, both of which may and sometimes do happen.

A combination of "Roach attachments" applied in this manner to the anterior teeth which are to be used as supports, or even where the shank of the ball is cemented directly into the tooth without either inlay or crown, or where, for any reason, it may be used in connection with a gold crown, or even with an "open-face" crown, and of "clasps" applied to the posterior teeth seems to offer a range of application well-adapted to meet all of the requirements of removable bridgework.

A typical application of these attachments where porcelain crowns are used on the lower first bicuspids is illustrated in Fig. 497, and in connection with large inlays, or so-called "Carmichael" attachments with a post of generous size in each, as applied to lower cuspids, is shown in Fig. 498

Another typical case, showing the application of a Roach attachment to a molar crown on one side, and of a clasp to a bicuspid crown on the opposite side, as a means of supporting the missing bicuspids and molars on one side of the arch only, is illustrated in Fig. 507.

Telescoping Tube and Split-Post.

The telescoping tube and split-post attachment is useful when applied to the *roots of the six anterior teeth*, or where the tube may be buried within the tooth, and without a too liberal sacrifice of tooth structure.

Manufactured Attachments.

The Roach, Morgan and other types of manufactured attachments will also be found valuable when used in connection with, and projecting from, either porcelain or gold crowns, or gold inlays, on the cuspids and bicuspids.

A New Attachment.

In addition to these, I am pleased to submit a method of attachment which, while perhaps but a modification of some of the previously mentioned types, is entirely new and, more or less, universally applicable.

Fig 499

This attachment consists in utilizing the grasping principle of an open tube with straight and parallel sides, which is the removable part of the fixture, in combination with a round wire, of about 12 gauge, attached to and therefore a part of the "fixed" portion of the structure, but lying in a *horizontal* position instead of in a vertical one, in its relation to the supporting fixture.

Such an attachment may be made by utilizing the tube of a "Roach" attachment in combination with 12-gauge clasp-metal wire, and while simple and easily constructed is especially useful in extensive cases, where the abutment pieces are assembled, though equally applicable to less extensive, or to the most simple cases. (Figs. 499 and 500.)

It is easily applied, easily tightened when loosened by wear, takes up but little space, does not require absolute parallelism when more than one is used on the same fixture, is applicable alike to either gold or vulcanite work, and is secure.

The conception of this attachment on my part was forced upon me in a very interesting manner. About a year and a half ago I inserted a large fixture in the upper jaw, involving the six anterior teeth and the two third molars, the latter being joined to the former with an iridio-platinum wire, 12 gauge, resting upon the summit of the ridge on each side. In about the center of the wire on both sides a vertical split-post was attached. This constituted the fixed structure, which was cemented to place, the split posts supporting a removable saddle, which supplies the bicuspids and molars.

Fig. 500

A few weeks after the completion of the case the patient returned with one of these split-posts broken away from the fixture, leaving nothing to hold that side in place. At first this seemed a calamity, which meant only the destruction and removal of the fixture, and the making over of the entire case. As this was not a particularly pleasant procedure to anticipate, and as necessity has always exercised a maternal influence upon the possible inventive ingenuity of man, it occurred to me that I might obtain attachment to that wire by grasping it with an open cylinder, or tube, lying parallel with it, and thus avoid removing and rebuilding the whole appliance. This I did, with the result that this side worked so well, and seemed so much stronger than the one where the vertical split-post remained, that I subsequently ground it off and used the open tube on that side also, and the utilization of this form of attachment in many cases since then has given me more satisfaction than I have ever obtained from any other method.

Technique.

In the application of this attachment in all cases where the supporting wire extended *distally* from the fixed portion of the structure, and where it lies on the summit of, and parallel with, the ridge, it is essentially necessary that it should be supplied with a "head," which will prevent any slipping or sliding of the removable structure. (Fig. 501.)

If such a provision is not made some movement and loss of stability will result from the stress of mastication. But when this wire is placed at an angle, or projects toward the center of the plate, such provision is not necessary. (Fig. 5 shows both styles.)

Fig. 501

Fig. 502

Gold Saddles.

When used in connection with gold saddles, the fixed portion of the structure, including the wire extensions, should be completed and cemented to position on the supporting teeth. When firmly and securely attached, the open tubes should then be placed in position in their proper relation to the wire extensions, and a bite, in wax, and impression in plaster then taken.

When the impression has been removed the tubes should be detached from the wire and placed in position in the impression, and held securely therein with a bit of melted wax if necessary.

A "dummy" wire of German silver, which should be a counterpart of the original, though somewhat longer, should now be fitted into the tubes as they lay in the impression, and the latter then varnished and filled with a good soldering investment material. The presence of the "dummy" German silver wires causes the tubes to be held securely in position on the model when separated from the impression.

Cast Saddles.

When the saddles are to be made by the casting process, as soon as the model has been obtained, each of the open tubes should be carefully detached and a small piece of round, iridio-platinum or clasp-metal wire of about 17 gauge, just long enough to project slightly beyond the tube at each end, soldered to the center of the tube. (Fig. 502.)

Place the tubes back in position on the model, then varnish over the entire surface well in order to facilitate the removal of the wax pattern,

Fig 503

and then mold very thin wax to the desired outline of the saddle, and cut out the wax to *expose* the wires on the tubes. This will leave a hole in the wax saddle through which each wire will be exposed.

Now stiffen and otherwise perfect the wax pattern; then adjust the sprue formers—remove, invest and cast, using coin gold. The wax saddle, or pattern, may be stiffened with a bead of very hard wax, or any

change of form may be overcome by covering it with a thin coating of casting investment material before removing it from the model, and after the sprue formers have been attached. When the casting has been made, the opening through it should be trimmed until, when fitted to position over the model, the wire on the open tube will project through.

The relation between the saddle and tube, with its wire lug projecting through, should now be securely sustained with hard wax, removed from

Fig 504

the model, invested, and soldered, after which the piece may be again placed on the original model, and if to be joined with each other by means of a palatal strip, if in the upper jaw (as illustrated in a typical case in Fig. 503), or a lingual wire, if the lower jaw (Fig. 504), these should now be fitted, and the attachment of all parts then made by soldering directly on the model.

After the substructure has been thus completed, it should be placed in position in the mouth, and a bite in wax and impression in plaster then taken, after which the teeth may be arranged and the removable part completed in the usual manner.

In the construction of cast bases, if a good model of a high-grade investment material is obtained, and if the wax base is carefully formed, made sufficiently thin and properly stiffened, the process offers every assurance of accuracy of adaptation and of strength, and the possibilities are unlimited. For all forms and sizes of saddles, or bases, coin gold seems to be especially adapted to cast work, and to afford all of the integral strength ordinarily demanded.

Vulcanite Work. While this attachment is equally useful when confined to simple vulcanite cases, still to have the best results the open tube should be attached to a palatal bar, or lingual wire, with solder, wherever possible, as illustrated in a typical upper case in Fig. 505.

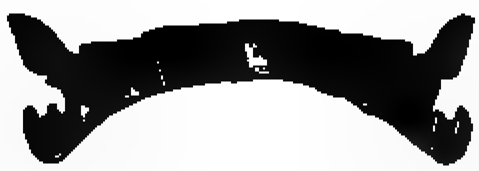

Fig. 505

When used in this manner the proper position is securely sustained, and the saddles and attachment of the teeth may then be made with vulcanite.

Fig. 506

In this procedure the technique is the same as previously described.

Where the case is to be made *entirely of vulcanite,* however, the open tubes should be placed in position in the mouth and the bite and impression taken.

When the model has been obtained and mounted upon the articulator, the open tubes should be removed, and a piece of 16-guage iridio-platinum or clasp-metal wire, slightly flattened, and with each projecting end bent away from the open tube and notched, should be securely soldered to the center of the tubes. (Fig. 506.)

Each of the open tubes should then be mounted to position on the model with *cement,* allowing a slight surplus to remain.

When this has been hardened, the relation will be securely sustained, after which the case should be completed in the usual manner as for any vulcanite work.

A similar attachment, known as Gilmore's, is now being manufactured, and may be easily obtained by those who do not care to make their own.

Construction of Fixtures.

When the type and number of attachments which are to be used for the purpose of anchoring removable bridges or partial dentures to the remaining natural teeth have been determined, and each attachment has first been made separately, it then becomes necessary to decide how the body of the structure which is to support the artificial teeth shall be constructed.

While vulcanite *alone* may be used for this purpose, *economy* is the one and only advantage to be derived from its use, and the best results, from the viewpoints of both strength and hygiene, are to be obtained by the use of gold, either in combination with vulcanite or alone, or of platinum in combination with porcelain.

In the casting process, coin, twenty-two-, or even twenty-karat, gold may be used for the structure, and the artificial teeth subsequently attached thereto with vulcanite. This is probably the most typical type of construction. In cases where any considerable amount of restoration *is not* demanded, however, ordinary replaceable porcelain crowns, bridge teeth, vulcanite, or diatoric teeth may be used by first molding the wax to the model and to the teeth, and then casting the entire body of the structure and subsequently cementing the teeth to this, thus using no vulcanite and avoiding the danger of casting directly to the porcelain. Or, where considerable restoration is demanded, and where the cosmetic requirements indicate porcelain, an alloy of five or ten per cent. of platinum in pure gold may be used in casting the base, and the teeth afterward soldered to this with pure gold. The restoration may then be made with low-fusing bodies and gum enamels, being sure to use those which fuse below the melting-point of pure gold, such as Jenkins' "Prosthetic," Brewster's, etc.

Small Cases. Perhaps the most simple, typical and universally applicable type of construction is indicated in supplying teeth on one side of the arch only (Fig. 507), or in small anterior cases (Fig. 508), and consists in making a gold saddle

and attaching the artificial teeth to it by means of vulcanite, which may be done by casting, with accuracy and facility, without dies, counter-dies or swaging, and with a degree of certainty measured only by the operator's skill.

Fig 507

In this procedure the completed crowns or inlays, together with the removable parts of the attachments used therewith, should be placed in position in the mouth, and a good impression obtained in plaster and a model then made of a good, smooth investment compound. When the

Fig 508

latter, with the attachments in place, has been obtained, it should first be properly treated to prevent the wax from sticking to it. Varnishing with shellac and then with sandarac, and, when these have dried thoroughly, with glycerine or thin oil, will usually answer this purpose nicely. Or, as a means of affording a close adaptation and a smooth surface, and pre-

venting the wax from adhering to the model, No. 4 gold-foil may first be trimmed and burnished over the working surface, and this subsequently invested with wax.

The wax saddle or base should now be formed to the model and trimmed to the desired outline. This may be accomplished by using the

Fig. 509

Fig. 510

thinnest possible form of sheet wax especially prepared for this purpose, such as is made by Ash & Sons, or ordinary baseplate wax, rolled out thinner. The saddle may also be made by first melting a hard wax, such as is used in inlay work, in a spoon or other suitable vessel, and painting it on the model with a brush until the desired outline and thickness obtains.

In the use of the thin sheet wax, which is regarded as best, however, it is always well to stiffen it with a bead of melted *hard* wax here and

there, as a means of precluding the possibility of any change of form in removing the case from the model, or in subsequently investing it.

When the proper outline and thickness are thus obtained by either of these means, provision for the subsequent attachment of the vulcanite should also be made, either in the wax or by sticking small scraps of gold or platinum plate or wire into the wax, allowing the surplus ends to be exposed. (Fig. 509)

Fig. 511

Investing and Casting.

When all of these requirements and precautions have been observed, the case is now ready for the attachment of the sprue-wire and for investing and casting.

In this connection the successful casting of large pieces depends, first, upon the manner in which the sprue-wire is attached, and upon the formation of a sufficient number of channels leading from it and extending to all parts of the mold, which procedure is usually advisable when the piece is larger than for two teeth, in order that the fluid metal may reach every part of the mold before it begins to cool; second, upon properly and thoroughly heating up and burning out the wax; and, third, upon the use of as much *surplus* metal as the size of the crucible will conveniently accommodate.

If these precautions, together with the use of a *clean ingot of a good grade of metal in each casting,* are observed, there seems to be no limit to the size of the piece which may be successfully cast, except, perhaps, the size of the flask and of the machine to accommodate it; and the percentage of failures will be reduced to a minimum in proportion as these features of correct technique and careful detail are developed, and minutely and painstakingly executed.

The method of attaching the sprue-wire and the manner of making provision for the formation of channels, which is done with a small roll of wax about the same size as the sprue-wire, are illustrated in Fig. 510

If it is desirable to cast directly to or *"pick up"* the removable part of an attachment, or a clasp, and thus have it become an integral part of the casting, such parts should first be loosened and detached from the model, and a small extension of wire or clasp-metal sufficient to insure strength in their subsequent attachment to the casting soldered to them with a high grade of solder, after which they may be replaced in position on the model and waxed up and removed with the base, prior to investing.

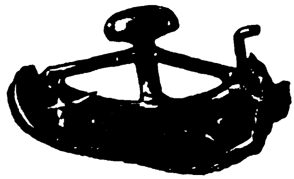

Fig. 512

Or, if it may seem preferable to first cast the base and subsequently attach such pieces with solder, the wax may be molded and carved to fit closely to and around them, as illustrated in the case of a Roach attachment in Fig. 511. When the piece has been cast (Fig. 512), and finished, the relation between them may be sustained with hard wax, when the whole can be removed from the model, invested and soldered in the ordinary manner; or, if the model has been made of investment material, the soldering may, of course, be done directly upon it, without removing the parts, which is regarded as the best procedure.

In the former method, however, the model may be preserved for the subsequent attachment of the wax "bite," which should have been obtained just previous to the taking of the impression.

Larger Cases.

Passing from the smaller class of cases to those involving a greater area of contact of the removable piece with the contiguous soft tissues, such as is demanded by the replacement of a greater number of missing teeth, and which increases, of course, in proportion thereto, a not uncommon class, among others, is one which is always more or less difficult, and which involves those conditions where teeth are required upon one side of the arch only, and where the absence of any posterior teeth on that

side would ordinarily admit of anchorage of but one end of the fixture, which is usually so inadequate as to be impracticable and invariably unsuccessful. Whether it be in either the upper or lower jaw, the difficulties in these cases may frequently be overcome by extending the fixture over or around to the opposite side of the arch, and then obtaining some form of anchorage upon that side also, thus imparting stability in the fixation of the entire structure.

A practical illustration of this class of cases, as applied to the upper arch, wherein the greatest difficulties are usually encountered, and in which the base, forming a saddle to support the missing teeth and extending transversely across the palate, together with a Roach attachment in an inlay on each side of the arch, and which was cast of clasp metal in

Fig. 513

one piece, is shown as the case originally presented in Fig. 513, and after the completion of the fixture in Fig. 514.

While a proper arrangement of the channels leading from the spruewire to various parts of the saddle, as previously indicated, together with an observation of the other requirements, will usually insure a successful casting, if any great difficulty is anticipated or encountered, such cases may be made in two separate pieces or castings—the saddle, which may be made of thin coin or 22-k. gold in one, and the somewhat heavier and thicker piece extending across the palate—which should be cast in claspmetal—in the other, and the two then subsequently united with solder. To insure strength in such joints, however, it is always well to dovetail one into the other, as will be subsequently described.

The same condition is also often found in lower cases, and successful fixtures demand a similar procedure and may be constructed in like manner. Fig. 515 illustrates a typical case. In the lower arch, however, the saddle should be cast separately, and the extension to the opposite side of the arch made of round clasp-metal or iridio-platinum wire from 12- to 14-gauge, and subsequently soldered to the saddle and clasp at the same time.

Or a casting instead of a wire, providing it is made of a good grade of clasp-metal and sufficiently heavy, may be made all in one piece, and is recommended by some because of being better adapted to the conformation of the arch, and yet less bulky and therefore affording less obstruction to the movements of the tongue.

For such bars and clasps, however, and for all cases where toughness and resiliency are demanded in certain parts of a fixture, *drawn*

Fig. 514

wire or *rolled plate* is undoubtedly better, for the reasons already mentioned.

In this particular case the molar crown with the "ball" part of the Roach attachment for the opposite side was made first. The bicuspid crown was then made and a clasp of 26-gauge clasp-metal adapted to it. The bite and impression with these in place in the mouth were then procured, and when the model was obtained and mounted upon the articulator, the saddle was molded in wax to fit the model and the clasp and to accommodate three Davis crowns. After casting the saddle, and attaching it to the anterior bar and clasp with solder, the Davis crowns were

Fig. 515

Fig. 516

then cemented to place, thus avoiding the use of vulcanite, which makes a splendid type of construction where the display of gold is not objectionable.

Extension Bar Bridges.

The extension of a *fixed* arm or projection permanently and securely attached to the supporting teeth at one end by means of crowns or inlays, and resting firmly upon the ridge, is also a useful means of anchoring removable fixtures, and is particularly applicable to the casting process because of the necessity for obtaining a close adaptation of the saddle or removable fixture to the supporting bar. A method devised by and used with considerable success in these cases by Dr. H. E. S. Chayes, of New York, was described at length on page 102, ITEMS OF INTEREST, for February, 1909 (Fig. 516).

The intricacy of the design, however, and the difficulty of manipulating 22-gauge clasp-metal to meet these requirements makes the use of such methods more or less impracticable in the hands of the average operator.

More generally applicable and, in some respects, better results are to be more easily obtained by utilizing the tube and *split-post* method in connection with Davis crowns, or any of the other separable dowel porcelain crowns, in the following manner:

The crowns or inlays for the supporting teeth should first be made separately and then united. In this connection the extension bar should not project beyond the supporting teeth farther than a distance equal to their combined width. In the case to be illustrated the two bicuspids were crowned with Davis crowns with cast bases, each having a narrow band as previously mentioned in connection with single-crown work. The bases or caps for these were then soldered together. With these then in place, a "bite" and impression should be taken, the model made of investment material, and the case mounted upon the articulator.

Davis crowns, or other porcelain teeth of similar design, should then be selected and ground to place on the model, and to fit the occlusion, allowing, of course, sufficient room for the bar and saddle. When so ground, short tubes should be made to fit the holes in the porcelain crowns, and these should be drawn from 30- or 32-gauge platinum. If desirable, the holes in the porcelain teeth may be enlarged to any reasonable extent with small stones in the engine. When tubes for each tooth have been made and fitted, the joint should be soldered with pure gold and one end closed.

Two pieces of half-round, or "D" wire, of iridio-platinum or clasp-metal should then be placed with the flat sides together and tacked at one end only with solder. This may now be placed in a small pin-vise and turned down with a fine file until the split-post fits the tube snugly.

When closed tube and split-post have been made for each porcelain tooth (and these may be made and supplied by the manufacturer), they should then be trimmed until the tube projects about 1-16 of an inch beyond the hole in the tooth, and the split-post as much longer as the space between tooth and model will permit.

A small roll of wax should then be placed on the model and formed to the outline of the desired extension bar, being careful to fit it closely to the abutting crown or inlay. When trimmed to about the proper outline, each tooth with tube and split-post should then be placed in position on same. The soldered or closed end of the split-post being purposely left longer than the tube, will at once engage itself in the wax and remain there, while porcelain tooth and tubing are being removed, thus admitting

Fig 517

Fig 518

of the easy detachment of both, and insuring the proper relation between the split-posts and the wax-bar, for the subsequent accommodation of tubes and teeth. It must be observed, however, that these posts are perpendicular and parallel. When such an adjustment has been obtained, the wax-bar should be removed, the sprue-wire attached and the casting made in clasp-metal. To insure a strong attachment between the ends of the split-posts and the casting, however, the ends projecting into the wax-bar should be roughened and notched, a precaution previously emphasized, and it is also well to use whiting, or to slip a thin piece of mica in between the open ends of the split-posts, in order to preclude their becoming united during the casting process.

When the extension bar has been cast, it should then be finished, fitted to place on the model, *slightly embedded therein,* and then soldered to the supporting crowns.

This, the *fixed* part of the case, when finished, should be placed in position in the mouth and a bite and impression taken (Fig. 517). When mounted again upon the articulator, the porcelain crowns should first be oiled to prevent the wax from sticking to them, the tubes inserted into the holes and the removable saddle then made in wax.

If the saddle is to be made in gold by casting, which is usually preferable because of using an all-porcelain tooth, as soon as the wax-base has been formed, the porcelain teeth should be carefully removed, allowing the free exposed ends of the tubes to remain embedded in the wax; the sprue-wire is then attached and the case invested for casting, in which procedure it must be observed that the tubes are thoroughly filled with investment material.

a *b*

Fig. 519

When the piece has been cast and finished (Fig. 518a), the teeth should then be cemented to place (Fig. 518b), after which the fixed part of the attachment may be mounted permanently (Fig. 519a), and the removable portion placed in position, when the mounting has become secure (Fig. 519b).

The advantages of this type of construction lie in the facility and accuracy with which the fixture may be made and the strength which is to be obtained by the casting process, together with the ease with which tightening of the removable part may be effected at any time, simply by spreading the split-posts.

The *removable* part, or saddle, may be made of vulcanite instead of gold by simply soldering a projecting lip of metal to each tube before waxing up, as a means of insuring attachment of tubes and then waxing up, removing, flasking, packing and vulcanizing in the ordinary manner.

In the construction of bridges of this type it must be remembered that the extension bar acts as a lever, and that the tissues upon which the

saddle or removable part of the case rests are more or less yielding; hence, in the excursions of the mandible, the supporting teeth receive stress in both vertical and lateral directions.

Provision for overcoming vertical stress, in the method of Dr. Chayes, is made by grinding or filing off of the top of the extension bar, thus allowing the removable fixture to rest more firmly upon the gum, while the collapsibility of the spring accommodates lateral stress, thereby relieving the supporting teeth to a marked degree.

The same provision against vertical stress is also to be obtained in the tube and split-post method by simply grinding off the top end of the split-posts so that they do not touch the bottom of the tubes. Similar provision against lateral stress, however, is only to be obtained by having

Fig [illegible]

the saddle as wide as possible, and well adapted to the tissues upon which it rests, which should always be well absorbed before the introduction of such a type of construction.

A more extensive case, and one that shows the possibilities of casting to a very marked degree, is shown in Fig. 520

In this case, a fixed bridge, carrying a cap with a tube adapted to the root of the central incisor, and the ball of a Roach attachment, was first made and mounted (Fig. 521). A Davis crown, having a cast base and "split-post" dowel, was then made to fit the cap on the central incisor. The model was then obtained and the saddle made in two separate castings, the one covering the ridge being cast in coin gold, and that extend-

Fig. 521

ing across the palate in clasp-metal, a "dovetail" joint between the two being provided (Fig. 522). These two castings were soldered directly on the model and at the same time the cap for the Davis crown and the tube for the Roach attachment was soldered. All of the teeth, except the Davis crown, were then attached with vulcanite, and this one tooth finally mounted with cement. The completed case is shown in Fig. 523.

In still more extensive cases, involving the replacement of teeth on both sides of the arch, as illustrated in Fig. 524, the casting may be made in three sections. In the case shown, Roach attachments were used on gold crowns on the molars; the two saddles covering the ridge were first cast separately of five per cent. platinum in pure gold. The section

Fig. 522

covering the palate was then cast of clasp-metal. When the castings were finished and fitted properly to place on the model to the tubes, and with each other, the teeth were then attached to each base with pure gold, and each side finished separately with Jenkins's prosthetic body and gum enamel. These were then placed in position on the model, together with the palatal section, and the whole invested. The three sections and the tubes were then united with 20-k. solder. The completed case is shown in Fig. 525

By this means porcelain was used for cosmetic reasons, and yet the resiliency of the tubes of the Roach attachments, and of the palatal

Fig. 523

section, was in no manner modified by the heat of the furnace in fusing the porcelain. In similar cases, where the teeth are to be attached with vulcanite, the fixture may be made in three sections, as indicated, or cast in one piece, with clasp-metal, as may be preferred.

In lower cases of similar character, the two saddles may be made separately and subsequently united with a 12-gauge bar of clasp-metal, or iridio-platinum, which is regarded as the best procedure, or the entire fixture may be cast in one piece, as shown in Figs. 526 and 527.

While castings of this size, and even more extensive ones, such as are illustrated in Figs. 528 and 529. may often be made in a single piece, difficulty in removing the wax from the model without endangering its shape, or of suitably accommodating it in the flask during the process of investing, may indicate or possibly even demand making it in two,

or even three, pieces, and subsequently uniting these with solder, which, as previously mentioned, may be done with facility.

Better results may often be obtained thereby, however, than are afforded in swaging, and the time required in the making of models, dies, counter-dies, and in swaging is also saved.

Fig. 524

Fig. 525

Fig. 526

Fig. 527

Overcoming Simple Difficulties.

Any difficulty encountered in removing the wax base from the model just prior to investing, on account of undercuts, etc., may be easily overcome by first breaking the model at these points, and then reattaching the broken piece or pieces with wax. When the wax base has been made and is ready for removal and investment, the broken pieces may first be carefully detached and the wax then removed.

Any possible distortion of the form and shape of the wax during its removal from the model and subsequent investment, no matter how

thin it may be, may also be easily overcome by first covering it over with a thin layer of investment material while on the model. When this has crystallised, the protected wax base may then be removed and the investment completed with ease and without danger. In such instances, however, the protecting layer of investment material, which has already crystallised, should be well moistened before the fresh mix is added.

in extensive cases is illustrated in Fig. 529 where, with but a minimum number of remaining natural teeth to serve as supports, all of the advantages of a "fixed" structure are obtained with a minimum of stress upon these teeth—any one of which possesses the combined strength of all. Add to this the possibilities of restoration, and the sanitary condition resulting, and it is evident that the success of such fixtures, in view of the possibilities of obtaining accuracy of adaptation by the casting

Fig 530

process, is unquestionable. In this case inlays were made for the molars on each side and an ordinary cap and dowel for the cuspid roots. These four pieces were then united with a 12-gauge round clasp-metal wire, having a vertical split-post attached on each side in the region of the bicuspids. This fixture was then cemented to place, and the removable one then made with a broad saddle resting upon the ridge and wire, and tubes to engage the split-posts (Fig. 530). The completed case, with removable fixture in position, is shown in Fig. 531

Removable Attachments in Combination with Porcelain.

In the construction of removable fixtures involving the anterior teeth, and particularly where the extent of absorption demands considerable restoration, any form of attachment which is adapted to the requirements of anchorage, *and which will withstand a higher fusing point than that of pure gold*, may be used, and the casting made of five or ten per

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Fig. 528

Fig. 529

Assembled Abutment Pieces.

The usefulness and practicability of assembled "abutment pieces" in the construction of removable fixtures increase in proportion as the size of the case increases, and the number of supporting teeth decreases. A typical application of the practicability of this principle

in extensive cases is illustrated in Fig. 529 where, with but a minimum number of remaining natural teeth to serve as supports, all of the advantages of a "fixed" structure are obtained with a minimum of stress upon these teeth—any one of which possesses the combined strength of all. Add to this the possibilities of restoration, and the sanitary condition resulting, and it is evident that the success of such fixtures, in view of the possibilities of obtaining accuracy of adaptation by the casting

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cent. platinum in pure gold. When such a casting has been made, suitable teeth may be selected, ground to the proper adjustment and soldered with pure gold, after which the case may be finished with Jenkins's Prosthetic, Brewster's or any of the low-fusing bodies.

Where the type of attachment used will not withstand the casting of this percentage of gold and platinum alloy, the casting may be made to fit closely around them, and their attachment to the finished piece subsequently made by soldering.

Fig. 581

In many cases this is an advantage, for the reason that the attachments are not subjected to the heat of the furnace in fusing the porcelain, and, therefore, retain their original strength and resiliency.

It must thus be observed that the scope of casting, as applied to the whole field of dentistry, and particularly to the field of prosthesis, has already revolutionized our methods of practice, and seems to possess never-ending possibilities, and in the light of our present achievements it is apparent that the size of the fixture to be cast and the percentage of successes in casting are but a question of development.

This is evidenced by the fact that even full upper dentures of desired and uniform thinness are already being successfully cast in gold by Drs. Taggart, Van Woert, Solbrig and others.

Whether the influence of the casting process upon the molecular

arrangement of the metals and alloys so used for full and very large cases, however, will admit of the same accuracy of adaptation that is now obtainable in smaller cases, appears at present to be somewhat doubtful. It seems probable and reasonable, however, that this phase of the casting process is also but a question of development.

In this connection, the "artificial stone" investment material suggested by Dr. Weston A. Price, of Cleveland, or something similar, may prove helpful, or may eliminate such doubtful possibilities, but for smaller work its sphere of usefulness seems limited.

All of the splendid achievements which are now within our grasp, however, and those which are to follow, have been made possible by the genius and untiring efforts of Dr. W. H. Taggart, of Chicago, to whom the profession must ever accord credit and should always remain grateful.

THE END.

INDEX

N

O

P

R

S

T

U